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GAS JOURNAL

LIGHT • HEAT • POWER • BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

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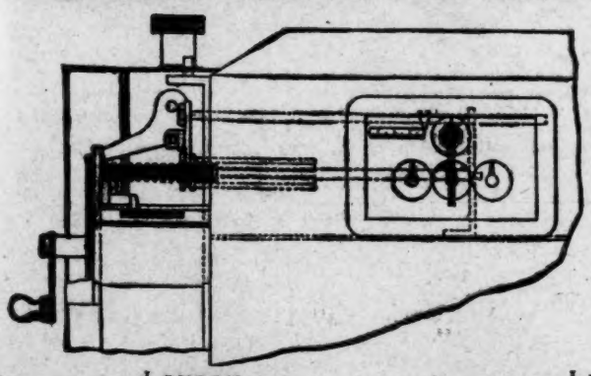

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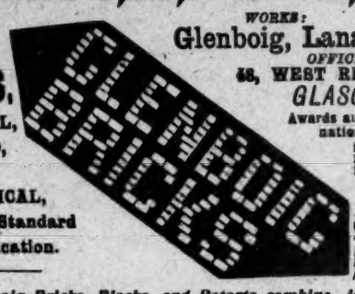

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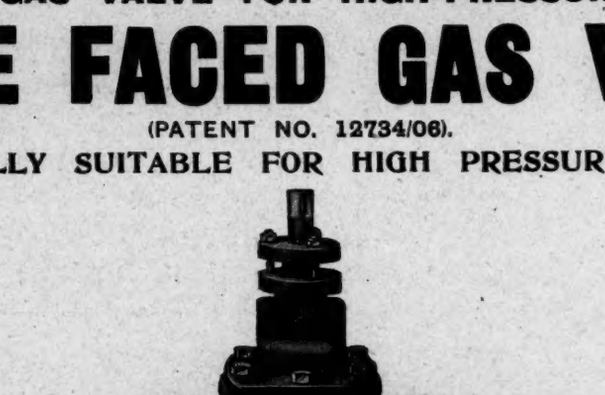

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VOL. CXL., No. 2844.] TUESDAY, NOVEMBER 13, 1917. [69TH YEAR.

EDITORIAL NOTES.

Steaming in Vertical Retorts—Effects and Causes.

IT cannot be said that we are altogether satisfied with the discussion on Mr. John West's valuable paper read on Thursday last before the Southern District Association of Gas Engineers and Managers. The paper, treating as it does of the economical carbonization of coal in the light of present and prospective requirements, was worthy a better effort on the part of those present at the meeting. It is a question whether there are not a good many professional gas men who do not yet fully or seriously appreciate that the sands are running out for the old carbonizing practices, and that methods and activities will have to undergo considerable change at the behest of economy, requirement, and competition. Gas undertakings are to become oil producers on scientific lines, without depreciating their position, but rather enhancing it, in respect of gas, coke, and the other products. The paper was very clear as to its intentions; but unfortunately there was a disposition on the part of speakers to run-off on to such side-issues—important as they are in their proper place—as inert materials in coal, inert constituents in gas, coal exports, and so forth. These points have little to do with the cardinal features of the paper—the economy of coal in carbonization, and the methods of increasing the productive power of continuous vertical retorts not only by enlarging the quantity of gas without greatly affecting the calorific value, but by augmenting the yield of valuable oils. Few speakers, except Dr. Perkin, Dr. Colman, and incidentally Mr. W. Doig Gibb, touched on these features. The methods of accomplishing the greater productive results per ton is by employing high temperatures outside the continuous vertical retorts, and by steaming, which under other conditions is not new. Returning to the retorts gas stripped of benzol and toluol is also beneficial, but probably not so much as steaming for gas-works purposes, and the supply of fuel oils.

The effects of working in this way are abundantly shown by the data in the paper, which, it is safe to say, will make a powerful impression upon the course of the industry's technical developments, and particularly because, as the evidence stands to-day, it is impossible to apply with the same efficiency similar methods with horizontal retorts, and to realize the same results. As to the causes of these effects, they were stated by Mr. West, Dr. Perkin, and Dr. Colman. Some light is also thrown upon them by comparison with horizontal working; and in our "Correspondence" columns, Mr. Thomas Glover directs attention to them. But there is much more to find out and to learn regarding the changes and reactions that occur in the retorts by introducing these methods of working. Generally, it is appreciated that the reasons the presented results in gas and oil are realized with these continuously worked retorts are: First, while exceedingly high temperatures are employed outside the retorts, the temperature inside at the top where oil vapours are primarily given off is practically of the low-temperature order, owing to the continuously incoming cold coal; so that the temperature to which the products are subjected before escaping from the retorts is not so high as in horizontal working. Secondly, that the passing of steam into the retorts continuously under pressure for the making of water gas, by its enveloping action protects from decomposition the hydrocarbons coming off from the lower parts of the charge, and accelerates their travel from the retorts. Hence there is a double defence against the degradation that occurs in high-temperature horizontal working. Or to adopt Mr. West's explanation, the water gas produced by the admission of steam no doubt causes several reactions to take place in the coal, which tend to liberate more of the hydrocarbons which were formerly left in the coke, or (we may add) assisted to thicken the deposit on the inside of the retorts. In these directions, we must look for an explanation as to why so much more gas is produced per ton of coal (*plus* the coke and steam), with but an infinitesimal depreciation of the calorific power, and so much larger production of oils per ton of coal carbonized—a production of oils which, from Table VII. in the paper, Dr. Colman calculates, is, under the conditions there described, some $7\frac{3}{4}$ gallons, as compared with (say) 3 gallons in ordinary horizontal working. Dr. Perkin also pointed out that the returning to the retorts of gas stripped of benzol and toluol (which stripped gas, by the way, never fell below 450 B.Th.U.) increased the tar by some 2 to 3 gallons, while the volatile matter left in the coke was reduced to zero, giving a good hard coke. However, what has been said here is the plain statement of the causes that contribute to the effects described by the data in the paper, which, when consideration is given to the work involved, is a monumental contribution from one who has consistently traversed the path to higher and higher stages of retort-house economy and efficiency until now well on the threshold of the octogenarian state, but still in the forefront in this matter with all the old buoyancy and energy that characterized him in the distant early days.

Before alluding to the data, it should be acknowledged that the work which the information represents is due entirely to the private enterprise of a Chemical Products Company of considerable position, and was carried out to determine the best carbonizing methods to adopt for their particular purposes. The exploration has meant a heavy expense, though a good investment; and therefore to the Chairman of the Company concerned (Mr. A. E. Barton) and his colleagues the thanks of the gas industry are due for permitting Mr. West to so freely pass on certain of the lessons of the investigation for its benefit. One thing in particular that can at once be said of the data is that they sound the death-knell of low-temperature carbonization as such for gas-works purposes; for it is clear that much that results from carbonizing at low temperatures can be secured by the system of retorts and methods described, without at all affecting plant capacity, and thereby capital and labour expenditure, while obtaining high gas makes of a calorific value and low inert content that comply with the approved quality for present-day uses. We cannot extract here all the lessons of the figures; but those who investigate them must not make the mistake that has already been made, that gas quantities and calorific values per ton are the only things that are in view in the quest for carbonizing economy and efficiency. The value of the several tests in the paper is enhanced, too, by the fact that the same coals were exposed to different carbonizing conditions—in horizontal and vertical retorts at high and lower temperatures, and in vertical retorts with and without steaming, and at different pressures of steam, which, with volume, appears to be a matter of some importance, and probably requires variation with different coal and different working conditions. There is more to be learned by research on this point.

For example, take the runs with Orrell nuts. The temperatures do not vary greatly in the four tests—1393° C., 1397° C., 1387° C., and 1415° C. Without steam at the first-named temperature, 14,084 c.ft. of 522 B.Th.U. gas was obtained. But at the second temperature, using steam at 25 lbs. pressure, with $\frac{1}{8}$-in. nozzle, 15,487 c.ft. of 506 B.Th.U. gas were realized; with the steam at 40 lbs. pressure, 16,607 c.ft. of 505 B.Th.U. gas were obtained; and with

steam at 45 lbs. pressure, just 17,460 c.ft. of 494 B.Th.U. gas. The ascent in make of gas per ton, while maintaining an approximation in calorific value per cubic foot, will be noted. The total B.Th.U. of the gas per ton of coal was also progressive—in the order of the results already quoted, 7,351,848 B.Th.U., 7,836,422 B.Th.U., 8,386,030 B.Th.U., and 8,625,734 B.Th.U. But in the fourth experiment, with 45 lbs. steam pressure, we have a falling-off in the make per retort per twenty-four hours, as well as in the gallons of dehydrated tar—the maximum in these respects being with the run with the steam at 40 lbs. pressure. Keeping to the same order, the makes per retort per twenty-four hours were 54,716 c.ft., 65,877 c.ft., 66,265 c.ft., and 62,203 c.ft. These figures show that possibilities in the matter of economical carbonization have not yet been exhausted, and so do others (united with those in Mr. J. E. Blundell's Manchester Institution paper) supplied to Mr. West by Mr. Lawrence Hislop and Mr. W. Tallentire. If Mr. West's 17,460 c.ft. per ton of 494 B.Th.U. gas causes any astonishment, the 20,640 c.ft. of 450 to 460 B.Th.U. gas, and the 23,000 c.ft. of 470 B.Th.U. gas, mentioned by Mr. Hislop in the discussion will raise up around him a host of sceptics. The fact of the matter is we are coming to the conclusion, after studying gas, calorific value, and tar oil figures from different quarters, where steaming is utilized under appropriate plant and working conditions, that the losses there have been under the old systems of carbonizing have not yet been assessed at their full value.

There is much else in the paper into which we cannot enter here; but, among the secondary points of interest, it is observed that Mr. Hislop endorses Mr. Blundell's experience that, by increasing the heats in the lower sections of the retorts, he has been able to decrease the CO_2 difficulty that formerly obtained with steaming. A novel feature is that Mr. Hislop uses a portion of the unpurified gas for heating his retorts—a matter referred to by the President (Mr. W. N. Westlake), and replied to by Mr. Hislop in the course of the discussion. Uddingston, it is also observed, finds that a 430 to 450 B.Th.U. gas gives a higher flame temperature and better results in incandescent mantles, cookers, and fires than a gas of 500 B.Th.U.; and at the gas-works less gas is required by the engines for doing a given amount of work. The carbonizing position is indeed to-day full of promise in respect of the realization of economies that will tend to that enlarged service towards which the industry is looking, but which will not be gained without research and continuous effort.

The First Gas-Engineer President of the Civils.

The Institution of Civil Engineers was founded on Jan. 2, 1818; and therefore the gas industry will count it a great honour that an engineer who was born into the industry, and has lived in it with great fidelity to its interests ever since, should, in the year which marks the centenary of the establishment of the premier engineering organization, be occupying its Presidential Chair. Mr. Harry E. Jones deserves this honour for his own work, and because he has now few (if any) contemporaries of such long-standing association with the professional side of the industry, or who have lived with such intimacy as he with the many movements that have made for the material development and progress of the industry, through the successful direction of one of "the "great sources of power in Nature for the use and conveni- "ence of man." And he tenants the Presidential Chair of the Institution just at a period, as his Presidential Address last Tuesday so completely indicated, when the industry to which he has devoted his professional life is at a point in its history at which knowledge and requirement are blending and promoting still greater service, in at present an immeasurable manner and degree. It is a period in which adroit handling will be necessary, and in which all the influence that can be brought to bear upon the work of development will be needed.

Thus it is that Mr. Jones in the Presidential Chair of the Institution of Civil Engineers is for the industry an honour and a very timely event. The honour has been long coming, though the gas industry has an engineering history extending back some period before the establishment of the Institution itself. The honour would have been further deferred for a period had not the pressing work of Mr. W. Barton Worthington and Sir John Aspinall, the preceding Vice-Presidents to Mr. Jones, found that succession to the chair just at this juncture was impossible. At the same time, the representation of gas engineering in the chair might have been earlier advanced had it not been that death removed men prominent in the gas industry, and prominent as members of the Council of the Institution. Upon the Council, the names of Sir George Livesey and Sir Corbet Woodall have had honourable place. It is not forgotten that Mr. Thomas Hawksley was President as far back as 1871; but gas engineering was not the chief line of professional work to which the energies and abilities of that famous engineer were applied. Mr. Jones stands in the distinguished office to-day as a civil engineer who has entirely spent his professional life in gas engineering. The reason that gas engineering has been treated by the Institution as a sort of derelict, and has not in the past received the same recognition as other sections of engineering, has been due to the innate indifference of past generations of gas engineers to the importance of their own place and that of the industry in the world's affairs. An industry of such an age as that of gas supply, and one so broadly based upon constructional and chemical engineering, and claiming engineering knowledge appertaining to transport by land and sea, mechanical operation, and more; an industry, too, employing many millions of capital, one drawing so largely upon the iron, steel, coal, oil, and other industries, and one providing so much that is necessary to the maintenance of other industries—has long possessed all the qualifications and to spare for more conspicuous acknowledgment than it has hitherto obtained in the realm of engineering.

This the industry is now receiving; and the Presidential Address which Mr. Jones delivered last Tuesday evening to a highly appreciative gathering of engineers in all spheres of the extensive art, put before them plainly the place occupied by the industry, not only in placid normal times but in war times, as a national asset, and as a factor in the country's prosperity and security. It also made manifest to them that its work has been built upon sound fundamental and economic principles, upon which accruing knowledge admits there are opportunities for considerable and valuable improvement. The address was delivered in the well-known breezy style of the President, and yet at the back of it there was the earnestness of one filled with a sense of the dignity and importance of the special branch of engineering in which he has lived so long. There may have been in the address nothing new for men who are daily moving in the work of the industry, but there was for those who live in other special spheres of the engineering profession. And the address has enlightened them not only as to the present position and the vast ramifications of the work of the gas industry, but as to its prospects and the aspirations of its leaders and workers.

Gas-Furnaces: Design, Manipulation, and Fuel.

The lecture that Mr. Arthur Forshaw, M.Sc., delivered to the Manchester Junior Association last Saturday week is a contribution to the subjects embodied in the title to this article that has characteristics entirely its own. In essence, it is a call to all concerned in the industrial developments of gas use to assess actualities correctly, and to bring into proper perspective the requirements to success, so as to keep this business entirely within the province of the gas industry, which will not be the case in regard to a large part if, at this the critical period in development, there is any negligence. This is an outlook which we refuse to adopt at the moment; but if eventually any considerable portion of the business is lost, the blame must be taken upon the shoulders to which it rightly belongs. It cannot be said that the makers of gas-furnaces have not done, and are not doing, their part in producing success by a systematic study of the chemical and physical requirements in respect of design and manipulation which contribute to the good conduct and efficiency of gas-furnaces and other industrial apparatus. The lecture in itself is a testimony to this, inasmuch as, as Mr. Forshaw indicates in its final paragraph, its contents are the accumulated results of the experience and the exercise of the brains of the whole of Messrs. John Wright & Co.'s technical staff, of which the lecturer himself is an important member. The makers are doing their share in fostering this business. Is the gas-supply industry doing its part?

The part of the gas-supply industry clearly does not consist merely in having show and demonstration rooms; it consists also in supplying gas suitable in character and price for the needs of manufacturers. To-day the gas industry is up-against strong rivals in this matter, so far as the larger

industrial consumers are concerned; and therefore the gas industry should have its attention pointedly directed to what may happen if it does not comply with the demand. What is wanted in the way of fuel by gas-furnaces is also what is wanted for domestic heating; and therefore what is said in relation to gas-furnaces has universal application, notwithstanding that Mr. Forshaw says "no subject is of greater importance to-day than industrial gas appliances." The statement is true in respect of industrial areas; but the developments so far as gas supply is concerned that will hasten the application of industrial gas-heated appliances are those that will also hasten the application of the domestic gas-fire and other heat uses. But it is to gas-furnaces that for the moment the lecturer now confines our attention. The fact has to be faced that coke-heated industrial appliances are declining in use—gradually it may be, but surely—owing to the superior over-all efficiency of gas-heated apparatus, where the gas-fuel is of such a character as to promote efficiency. The change from coke to gas for industrial purposes—a change which cannot be stayed, and no one would wish it to be stayed in the national interests—means that the gas industry is confronted by new conditions, which call for fresh policy. The market for coke for industrial heating operations must inevitably be a diminishing one; but signs are strongly in evidence that it is merely a transfer of use, if the position is handled with due circumspection. What is lost in the way of coke business for metallurgical work can be compensated by the use of coke for industrial steam-raising. And the business lost in the coke heating of furnaces can be made up by the sale of gas, if—this is important—the gas possesses the qualities required.

A highly significant passage found towards the close of the lecture is this: "Gas-heating engineers cannot look with "equanimity on the reduction of calorific power if it is "brought about by dilution with inert gases, nor do we "welcome continually varying percentages of water gas or "high specific gravities." Again, "It is highly important "in many gas-furnace operations that high flame tempera-"ture should be attained. As the percentage of incombust-"ibles rises, this property is impaired." Still further: "Gene-"rally speaking, we do not mind low calorific value; we "have melted much metal by blue water gas alone." Upon this there is an appeal to gas engineers to standardize the chief product of gas-works; so that, whatever the part of the country, a constant quality of gas can be counted upon. If this appeal is unheeded, there will be a check to the growth of the industrial load of gas-works; while heed and compliance will favour expansion all along the line—expansion in demand for, and the output of, furnaces, which means expansion in the sale of gas. What is the alternative in the larger factories? Rivals are already in the field; and gas-producers are available that can give cheap gas of uniform quality suitable for the realization with furnaces of high flame temperatures. If, however, manufacturers can secure, on tap, a gas with the constancy they require—a gas not burdened with avoidable inert constituents—they will prefer it to being saddled with an additional process. We do not want to see repeated in industrial heating the experience of the growth of producer gas that was once witnessed in industrial power. The fact, however, remains that of late complaints have in some quarters been all too frequent of the varying efficiency of gas-furnaces. This, obviously, is through no fault of the furnaces themselves. It is due to one of two things—to erratic manipulation or the inconstant character of the gas fuel supplied. Which is suspect need not be specifically stated; but there are gas-supply districts where complaint is practically, if not entirely, absent.

There is here a question of policy that is to-day of predominant importance to the whole gas industry; and this is our reason for bringing to the forefront the monitory references made by Mr. Forshaw in his lecture. There is, however, the technical side of the lecture, bearing upon the design and manipulation of the furnaces themselves. The war has proved that, in the utilization of gas for metallurgical work, there is an elasticity that has enabled it, through the experience and investigation of the manufacturers of the furnaces and other gas-heated apparatus, to be applied to the countless special requirements that have arisen. But experience and investigation have also shown that efficiency forbids all random applications, as much as it does careless manipulation, and that economy bespeaks consideration for all that contributes to it. Comparison, too, with predecessors on fuel costs alone is an absurdity. There are other factors—capital and renewal charges in relation to output, labour costs, and rate, quality, and uniformity of production, all of which contribute to the sum-total of advantage, and so must be taken into account. The lecturer shows this. He shows, too, how every one of these factors has a bearing upon the rest. The character of the furnace may affect them all, and so may the quality of the gas fuel and the quality of the labour, which, of course, is less in quantity than formerly, owing to the greater productive capacity of the gas-furnace. There are furnaces that are not altogether blameless in respect of a deficient efficiency, and therefore of economy; but just as credit should be awarded where credit is due, so also should blame. Furnace linings, for instance, may be detrimentally affected not only by an insufficient ability to resist high temperatures, but by slag corrosion due to spilt metal (owing, maybe, to careless manipulation by attendants), and the neglect of the slag will mean reduction of output. In fact, the increased output of a furnace can only be assured by attention to all the factors that go to maintain a high temperature flow through the walls of the pot to the metal to be melted.

Pots and crucibles, too, can be greatly preserved by heed to points mentioned in the lecture. Among the satisfactory working conditions are flame quality and pressure constancy. Through pressure fluctuation damage may be caused to pots in a few minutes, which means the installation of a good governor. Want of proper control is not the sole cause of trouble in this direction. The deteriorating action of the fluxes on the inside of the pots at the level of the molten metal is a matter that has not yet been surmounted. But apart from these destructive influences, that longevity as measured by the number of melts is attainable is proved by the information in the lecture; and, be it noted, there is efficacy in the payment of a bonus to workmen for every melt realized by a pot above a given number. Life, too, is influenced by the character of the metal. Thus it is that it is impossible to give life guarantees other than those based on the number of melts; and here again continuity or intermittency of operation has its effect. Continuity and intermittency also affect fuel consumption results, which are further influenced by factory methods, by the physical conditions of the metals themselves, and by the pouring temperatures that manufacturers prefer to practise. Hence it is that consumption tests at the works of furnace makers and in factories have grave disparity; as have also actual consumptions in relation to work done as between foundry and foundry. What is required in this connection are standardized tests, so that one may know exactly what value should be attached to the figures; and in these days one does not know this when making comparison between published results.

However, there has been good advance made in furnaces for melting—in two lines particularly in attaining higher efficiencies. Naturally the lecturer had in mind in this connection the Wright-Brayshaw burner, and the arrangements for pre-heating metals, which also affects the heat efficiency and fuel economy of furnaces. More on these and many other matters is found in this interesting lecture, which is not confined to furnaces for melting, but extends to furnaces for the heat treatment of metal. But those who heard the lecture and those who read its complete text in our columns will see that the main intention of the lecturer, other than illustrating structural advances in furnaces and their operation, was to point the moral that to realize the objective of high efficiency, furnaces, manipulation, and fuel have all some contributory and indispensable part. Beyond that objective lie possibilities that will be worth all the effort expended upon their realization.

Alliance of the Gas and Electrical Industries.

HOWEVER many men in the electrical industry may think as the new President of the Institution of Electrical Engineers (Mr. C. H. Wordingham) regarding the relations of the gas and electricity industries, there are few with temerity to express their convictions in the public manner that he has done in times past, and again in the Inaugural Address that he delivered last Thursday evening. The general tendency of electrical thought is to monopolize all that imagination can be stretched to, and to deny to the gas industry any right of existence in the world's affairs, though appropriating its methods and utilizing its results in the manner that is electrically considered proper, though to the eventual disadvantage of the country's economy. But Mr. Wordingham will not allow to inhabit his mind visions in this respect that

are not founded on commonsense. His address compassed a large number of subjects, all interconnected and appropriate to these times when reconstruction of practices and new developments are receiving close attention through the larger outlook that the war has invited us to take. Among them was naturally that of fuel economy. There is, he told his audience, a tendency to confuse fuel economy with cheap power supply. But the two are distinct, although closely related. This is quite true; but, true as it is, there are even now a great majority of "engineers" who take the narrow view that economy of fuel only means the realization of a greater number of electrical units per ton of coal sent into the yawning mouths of boiler furnaces. They have no place for any idea that national need claims much more from the ton of coal than (on the present average consumption) approximately 500 electrical units, or 1,710,000 B.Th.U. from the—shall we say?—32 million B.Th.U. of the coal, or from the plants of front place efficiency 746 electrical units, or 2,551,320 B.Th.U. Economy of fuel has a larger meaning than this. When we speak of it nationally, a meaning attaches which takes into account something more than the interests of any single industry.

In this matter of fuel economy, Mr. Wordingham thinks that electrical engineers have been apt to arrogate to themselves too prominent a position. It only needs reference to past works and performances for support of this view; and, when such reference is made, it adds to the piquancy of the reproof contained in the words: "It is little short of "ludicrous to ignore the great gas industry, either in respect "of its consumption of coal, or of the experience of its gas "engineers and managers." This is precisely what might have been expected from one who for years has advocated a close co-operation, if not the fusion, of gas and electrical interests, and who believes that an appreciation of the soundness of this view is now gaining ground. We will go further, and say that we believe the war, and the work of the British gas industry in effectively standing between the mighty preparations in high explosives on the part of our enemies and absolute disaster for the Allies through want of preparation in that regard, have brought about a larger, if silent, respect on the part of many electrical men, whose former foolish wishes were for wiping the gas industry off the very face of the earth. The roots of the gas industry are deep, the girth of its trunk continues to enlarge, and its branches are still spreading outwards, and new ones are developing. Only recently, we saw that the "Electrical "Review" described the electrode industry as the "key" to the electricity supply industry. Incidentally, it also mentioned that the principal raw material of the carbon electrode industry is gas-retort carbon—a commodity which is available from no other source than gas-works. By inference, therefore, the gas-supply industry is the "key" to the electricity supply industry, besides serving it otherwise by assisting in the production of its plant and lamps. And now Mr. Wordingham holds "most strongly that gas pro-"duction will be an intermediary between the raw fuel and "the live steam, and so be concerned in the generation of "the electrical energy used." This is where he takes the broad and only legitimate view that economy of fuel must take into account those bye-products of gas manufacture and their derivatives upon which whole industries depend; and "it is here that the enterprise and the skill of the "chemist and of the gas engineer and manager come in." Coal carbonization for the manifold purposes for which the results are required is an industry in itself of immense proportions, which could no more be taken as an inseparable prelude to electricity generation than that industries requiring electricity could be annexed as pendants to the electricity industry. From the heat standpoint, electrical energy can never (except for special industrial operations), with thermal efficiency, replace combustion methods; and it is well that those of the electrical industry who indulge in excessive flights of imagination should be brought back to practical grounds by someone within it.

There must, however, be disagreement with Mr. Wordingham on one point in this connection. His view as to ultimate economy provides for the whole of the coal used being treated as near the pit as practicable. This indicates a restricted economic outlook. Let him study the entire production of a ton of coal as treated at gas-works, ascertain the small amount of loss due to this treatment, and then inquire whether there is anything that would justify the difference between the cost of the transmission of coal and the costs (including leakage) of the transmission of gas or electrical energy for any long distances, together with the distribution throughout the country of the coke and the other products from the pit seats of carbonization. His proposal, too, which is such a popular one among those who do not consider the whole consequences, fails utterly in its want of appreciation that there would follow as a natural development the concentration of all industries near to the place where the coal was treated, and this would mean the industrial starvation of large tracts of the country, and a concentration of population which would be undesirable in the largest economic interests of the country. For our internal welfare, there is good in well-ordered distribution of work as well as in concentration.

There is the question as to where the dividing line should be drawn between the work of gas undertakings as fuel or steam suppliers and that of the electrical engineers. Mr. Wordingham thinks that, after the coal has been treated, the electrical engineer should take the operations in hand; and he is of opinion the proposal that has been made (we take it he is referring to the one made by Mr. E. W. L. Nicol) is not sound, of drawing the dividing-line later on, and allowing gas-works to supply the steam. That is simply a matter of opinion, and does not dispose of the question of economy. There is no evidence whatever to support Mr. Wordingham. But *primâ facie* it seems a pity that heat units should be so lavishly evicted from gas-retorts in the shape of incandescent coke, and that they should be so largely wasted, when a considerable proportion might be utilized in developing steam by direct transfer to steam-generating plant. We can well understand that the President does not look with approval, even in the interests of possible economy, upon the relinquishing by the electrical engineer of any part of his existing technical territory. But he invites criticism and correction when he says: "Electrical engineers have "made the production and utilization of steam their own "field, and they are pre eminently experts in it; while "gas engineers have not been called upon to consider this "problem to any great extent, nor under the conditions "imposed by a generating station." We ask for proof of the pre-eminent expertness of the electrical engineer in steam production. Is it to be found in the records of the past? Is it to be found in that average expenditure of 4½ lbs. of coal per electrical unit generated? If not, where is it to be found? And regarding the gas engineer, has not Mr. Wordingham heard of the manufacture of carburetted water gas and blue water gas on gas-works? How there are numbers of works sending out 20 to 25 p.ct. of their total gas production through this means of manufacture; and in the palmy days of cheaper oil, there were some who sent out 30 to 40 p.ct. of the carburetted brand? The conditions of the steam supply to these water-gas plants are, and must be for reasons of economy, no less exacting than in, and the equal in magnitude to, many electrical stations. The address is an excellent one; but if it requires revision in certain respects, it is due to an unconscious restriction of point of view on the part of the President, and an insufficient examination from other points of view.

The Colliery Owners Rebel.

The control of the coal-mining industry is a big and thorny undertaking; and he would have been a bold man who dared to predict that it could be done, and yet give pleasure to everybody. It has been long reaching a stage approaching completion; but at length (as announced a fortnight ago in our "Parliamentary Intelligence") a Bill has been deposited in Parliament to give effect to an agreement which has been entered into by the Coal Controller and, on behalf of the colliery-owning interests, the Mining Association of Great Britain, and which relates to the compensation to be paid in respect of the control of mines and other matters arising out of such control. But though the Mining Association endorsed the agreement, the colliery owners generally are attempting to repudiate it. It is all a question of money; and, if one were blind to actual dividend payments, it might have been imagined, reading and listening to all that came from their side in the immediate past, that they were the most ill-rewarded traders in the whole country. The Bill is described by them as inequitable and unjust, and amendments will be pressed. The coalowners are not now disposed to regard the agreement as valid. They are as bad as the members of trade unions who rebel against the decisions of their executive officials. Counsel appears to have

encouraged the owners in their rebellion—that is, if it be true that the learned gentleman's opinion is favourable to the view that "even the companies which actually accepted the agreement are now released by the wage concessions made by the Controller, which alter the whole condition of the industry." But such a way of escape from the agreement has been frustrated by the counter move of the Controller in attaching 2s. 6d. per ton to the pithead price of coal, and retrospectively so far as works are concerned. The 2s. 6d. supplies ample covering to the increase of wages. We recently calculated that the latter represented about 1s. 8d. per ton of output. Objection to the calculation has been taken by one, and only one, coal representative. That it was not far out, we have the assurance of the "Iron and Coal Trades Review," which, after stating that it is evident the present coal production has fallen to a rate of about 250 million tons annually, remarks that, on this basis, "the increase in the cost of production caused by the special war wage appears to be about 1s. 10d. per ton."

Points of Dissatisfaction.

It may be taken that our contemporary is fully aware of the points of the agreement that has disturbed the rank-and-file of the colliery owners; and so we may accept it as a faithful guide. They are all Oliver Twists, and want more. They are guaranteed pre-war profits under certain conditions, with 5 p.ct. of any excess war profits that may be made. The pre-war profits that were made—the prices that succeeded the great coal strike are in memory, together with the strength of the foreign demand—were not at all bad. But nevertheless there is dissatisfaction. This is amusing when one remembers how painstaking and constant have been the efforts to show that increased costs of production have more than absorbed any additional revenue per ton, despite the published tale of the dividends declared in many instances. There is a condition attached to the payment of pre-war profits. It is that a colliery must maintain or increase its output. Exceptional circumstances will have consideration; but the condition will be a persuasive one. The provision for taking 95 p.ct. of excess profits, instead of the 80 p.ct. as provided by the excess profits duty, is another painful condition. What does it matter though if there are no excess profits, as the public have been given to understand on impeccable authority that there are not, that there should be this provision for their disposal? But that there are excess profits is indirectly admitted by the "Review" when it says that "some reduction of dividends may be looked for by the shareholders of the more prosperous undertakings." But these undertakings ought not to mind, in view of the benevolent purpose to which the additional 15 p.ct. is to be applied. It is to be utilized in the payment of compensation to concerns which may be entitled to it under the agreement, in order to bring their profits up to the guaranteed standard and in other ways. The colliery owners wish to make doubly sure of their guaranteed profit. It is understood that, in compliance with their wish, the guarantee is to be taken as a Treasury obligation, and not as solely dependent upon excess profits from the other collieries; and they desire this to be put in black and white in the Bill. What more the colliery owners can want, in view of the national conditions, is beyond our knowledge. But the one thing clear is that they are dissatisfied with pre-war profits, *plus* 5 p.ct. of any excess profits that may be made.

The late Mr. F. E. Moss, of Worthington, near Wigan, gas-coal contractor, left £35,134.

On Thursday, before the Belfast Association of Engineers, Mr. A. Percy Hoskins will read a paper on "Benzol Recovery."

Next Saturday afternoon, members of the Scottish Junior Gas Association (Eastern District) will visit the Cowdenbeath Gas-Works, after an inspection of which the visitors will be the guests at tea of Mr. J. B. Scott, the Engineer and Manager.

The list of those who have been recommended by the President and Council of the Royal Society for election into the Council, at the anniversary meeting on the 30th inst., includes the names of Sir George T. Beilby, Prof. Percy F. Frankland, LL.D., Dr. J. W. L. Glaisher, Prof. B. Hopkinson, M.Inst.C.E., and Mr. James Swinburne, M.Inst.C.E.

According to statistics compiled by the United States Geological Survey, the output of sulphuric acid in 1916, expressed in terms of acid of 50° B., was 5,642,112 short tons, to which must be added 443,332 short tons of acid of strengths higher than 66° B., not convertible into acid of 50° B. The totals include bye-product acid—that is, acid produced at copper and zinc smelters.

PERSONAL.

Mr. J. HEDLEY, of Dromore, co. Down, has been appointed Gas Manager at Portrush, in the room of Mr. Samuel Moore, recently appointed Gas Manager at Scunthorpe, Lincolnshire.

Captain J. D. WHITE, of the 8th Middlesex Regiment, who is a member of the staff of the James Keith and Blackman Company, Ltd., of London, has been awarded the D.S.O. for distinguished services in the field. He received this distinction at the hands of His Majesty the King on the 7th inst. Captain White has been on active service since the commencement of the war.

Corporal COLEBY, R.E., has received news that his son, Private W. S. Coleby, of the Yorkshire Regiment, has been awarded the Military Medal for gallantry in carrying dispatches under heavy shell fire. Private Coleby has been in France over two years; he and his father having joined up on the outbreak of war. Before enlistment they were both employed by the Middlesbrough Gas Committee.

Mr. and Mrs. WILLIAM DUFF, of Morecambe, celebrated their golden wedding on the 1st inst. Mr. Duff was Engineer and Secretary to the Morecambe Gas Company up to the time the undertaking was purchased by the Corporation in 1900. He has two sons still connected with the gas industry—one is the Engineer and Secretary to the Banbury Gas Company, and the other is the northern representative of the Richmond Gas-Stove and Meter Company.

OBITUARY.

JOSEPH BELL FENWICK.

A painful feeling was created in Retford last Saturday week by the news of the death, which occurred with extreme suddenness while he was engaged in dressing, of Mr. Joseph B. Fenwick, who for many years had occupied, with credit to himself and profit to the Corporation, the dual position of Engineer and Manager of the gas and water undertakings. The greatest sympathy has on all hands been expressed with the widow and family in their bereavement, which subsequent inquiry showed to have been caused by heart disease.

It was in the early part of 1892 that Mr. Fenwick gave up the management of the Windermere Gas-Works to go to Retford; so that he had been there about a quarter-of-a-century. During this period, he had almost remodelled the gas-works; the output of gas having been trebled, and the charge considerably reduced, while in course of time grants were made from the profits towards the relief of the rates. To cope with the growing demand for gas, three new holders were put up, from designs and specifications prepared by Mr. Fenwick; the last one having been erected sixteen years ago. The position of the water undertaking was also enormously improved.

Mr. Fenwick, in addition to being a skilled mechanical engineer and draughtsman, had the advantage of a large experience in the building of high-class engines and machinery for gas and water works. He was a member of the Institution of Gas Engineers, the Manchester District Institution of Gas Engineers, and the Eastern Counties Gas Managers' Association (of which he had been President). He was also one of the founders of the Institution of Water Engineers. He held numerous certificates, including first-class honours in "Gas Manufacture," and a silver medal. In Freemasonry, he had been W.M. of the Vernon Lodge, and was also associated with the Royal Arch Chapter, and had held high rank in the Province of Notts. For many years he was Almoner to the Vernon Lodge.

The deceased gentleman, who was 64 years of age, was a native of Newcastle-on-Tyne, and spent some years at South Shields before going to Windermere. He leaves a widow, three sons, and three daughters. The eldest son, Mr. Joseph Fenwick, is Assistant Engineer at York Gas-Works; the next, Mr. George Fenwick (who was wounded in France, and discharged), is the Manager of the Yeovil Gas-Works; while the youngest, Mr. James Fenwick (who has also been wounded), is now in England engaged on motor ambulance transport work.

Mr. Fenwick will be much missed by his brother managers, several of whom attended the funeral on Wednesday. The bearers were employees of the Gas and Water Works; and the Mayor and Corporation attended, with a large number of townspeople and others.

Mr. JOHN R. HEATH, who died at Hanley on Monday of last week, aged 56, was for a great many years connected with the Potteries works of the British Gas Light Company, Ltd., which were erected under his supervision. From considerations of health, he retired early in 1914 from the position of Engineer and Manager of the station—being succeeded by Mr. Harold E. Copp, who was then at West Bromwich.

Mr. WILLIAM DU BOIS DUDDELL, F.R.S., C.B.E., whose death has occurred at the early age of 45, had had a distinguished career as an investigator in connection with electrical science, and had been President of the Institution of Electrical Engineers and Hon. Treasurer of the Physical Society. Among other things, he was on the Advisory Council for Industrial Research. To "JOURNAL" readers, however, his name was more familiar as Chairman of

the National Committee on Illumination—a Joint Committee of the Institution of Gas Engineers, the Institution of Electrical Engineers, and the Illuminating Engineering Society. He was at the meeting in Berlin in August, 1913 (when the Institution of Gas Engineers were represented by Mr. W. J. Atkinson Butterfield and Dr. Harold G. Colman), at which the formation of the different Committees was agreed upon.

The "Journal für Gasbeleuchtung" of Oct. 6 contains a three-column appreciation, from the pen of Herr Rosellen, of Neuss, of Herr Bernhard Goldenberg, Chief Engineer of the Rhenish-Westphalian Electricity Works, who died on June 4. He was mainly responsible for the development of the system of supply of electrical energy in Westphalia from power stations consuming coke-oven gas from the coke-works in the Essen coal district. He likewise developed a scheme for the supply of coke-oven gas by long-distance mains to places in the Rhenish-Westphalian coal-fields. In 1916, no fewer than 44 communities were thus supplied with oven gas; the quantity furnished in the year being about 1570 million c.ft. Herr Goldenberg was also largely instrumental in developing the recovery of bye-products from Westphalian coke-ovens; and his biographer says that it will be owing in large measure to his activities in this direction that Germany will—in his belief—emerge victorious from the present war.

The Military Cross is to be handed to the parents of the late Lieutenant R. O. Jenkins, formerly of the Liverpool Gas Company's Supply Department. He was 25 years of age, and recently succumbed to injuries received in Flanders. Enlisting on the outbreak of war, Lieutenant Jenkins gained Sergeant's rank, and was subsequently recommended for a Commission. Upon returning to France after undergoing training and examinations, he was gazetted to his old battalion, at the request of his Commanding Officer. The deceased officer is said never to have failed to share the risk with any man to whom he had assigned perilous duty. The death is also announced of Captain G. E. Simpson, on the Flanders ridge, at the age of 24. He was a member of the Liverpool Gas Company's Rental Staff, and enlisted as a private, quickly gaining promotion to a Subaltern's position, and even more rapidly obtaining his Captaincy. Captain Simpson passed uninjured through the battles of the Somme last year. His end was instantaneous; and, having a premonition, before going into action, he passed over his cherished belongings to a brother officer, with a home message. Both officers were possessed of high qualities; and their loss is very much felt—especially by the Treasurer (Mr. Edwin Upton) and other officials.

DEVELOPMENTS IN COAL DISTILLATION OF LATE YEARS.

The Oct. 31 issue of the "Journal of the Society of Chemical Industry" contains a translation of a paper by Prof. E. Molinari in the "Annali di Chimica Applicata," dealing with "Developments of Important Chemical Industries in Relation to the War." The subjects dealt with are: (1) Sulphuric acid; (2) nitric acid; (3) distillation of coal; and (4) dye-stuffs.

As to the third branch of the inquiry, it is pointed out that the amounts of coal distilled for gas or metallurgical coke in the year 1910 were as follows: United States, 60 million tons; Germany, 40 millions; England, 46 millions; Russia, 5 millions; Belgium, 4 millions; France, 8 millions; Austria, 4½ millions; Italy, 1·4 millions. By distillation of all the coal tar then obtained throughout the world there would be at most an output of 100,000 tons of crude benzene and toluene; while by recovering the benzene and toluene from the illuminating gas, it would have been possible to produce 1,700,000 tons. Coke-ovens with plant for recovering benzene accounted for only 5 p.ct. of the possible yield in 1900, and 16 p.ct. in 1909 in the United States. In England, the corresponding figures were 10 p.ct. in 1900, and 28 p.ct. in 1909; while in Germany the output increased from 10 p.ct. in 1900 to 82 p.ct. in 1909. Phenol and picric acid are now prepared synthetically from benzene, by processes which had not been found suitable in times of peace. Benzene is treated with chlorine in the presence of iron as a catalyst; and the monochlorobenzene is nitrated and the product saponified. Or, benzene is sulphonated, and the sodium salt of the resulting benzenesulphonic acid fused with caustic soda to produce phenol, which is then nitrated to obtain picric acid. Picric acid thus manufactured in England, France, and Italy furnishes the greater proportion of the explosives used in the war. In Italy alone, one plant produces 16,000 kilos. of synthetic phenol per day from pure benzene obtained from Italian coal and from light tar-oils imported from England. From 50,000 to 60,000 kilos. of picric acid is produced daily by various factories in England by means of these processes; while, in France, the Société d'Usines du Rhône now produces daily up to 150,000 kilos. of phenol for the manufacture of picric acid. Other factories in France produce from 30,000 to 50,000 kilos. per day; while others, again, produce immense quantities of dinitrophenol. It is estimated that during the year 1916 approximately 1,805,000 tons of explosives were produced throughout the world—the chief consuming countries being: England, 200,000 tons; Germany, 540,000; France, 300,000; Italy, 45,000; United States, 160,000; Russia, 100,000; Japan, 90,000; Austria, 150,000.

MR. H. E. JONES'S PRESIDENTIAL ADDRESS

TO THE INSTITUTION OF CIVIL ENGINEERS.

The gas profession is honoured by the honour that has fallen upon one of its best-known members—Mr. Harry E. Jones—in being called upon to fill the Presidential Chair of the Institution of Civil Engineers; and many gas men were among the large audience who were gathered last Tuesday in the Meeting Hall of the Institution, in Great George Street, to hear him deliver his address.

Circumstances had combined to create a vacancy somewhat before the time at which, as he said, he "might legitimately, as one of the Vice-Presidents, have come to the chair." But one does not expect an emergency to find Mr. Jones unready to meet it; nor did it do so on this occasion. One regret, however, felt by him was because of the fact that, if he had been able to wait until after the war, he would have been in a position to give the members some interesting particulars as to how far his special branch of engineering had helped in the war; and then, again, the position of President this year is rendered somewhat more onerous by the approach of the Institution's Centenary. In the latter connection, it is gratifying to learn that Dr. Tudsbery (the Secretary) is preparing a record of the inception of the Institution, its stages of progress, the introduction of qualification tests, and the efforts that the Council are always making in order to secure recognition of the members in many important posts and offices in the State and municipalities. A compilation of this character will be a fitting mark of the Centenary, even though one must agree with Mr. Jones that "one always feels that the vital history of the Institution does not need much record of that kind, because it is written over the whole globe in the works of the members and in the long line of illustrious Presidents. Their work of promoting communication, transport, locomotion, navigation, and sanitation has extended civilization and prosperity over the whole world, and added to the welfare of mankind." As to himself, the President told his hearers that, though trained originally in mechanical engineering as a locomotive engineer, he has been practising for over forty years in gas-works—"a branch of engineering which sends to the Institution not more than the small number of ninety representatives, members, and associate members, which is about 1 p.ct. of the total number of members." Therefore, he added, great indulgence and consideration have been extended to them; and he ventured to think that the Institution of Gas Engineers will feel that there is encouragement to them in the acceptance by the members of a gas engineer as President.

THE GROWTH OF GAS CONSUMPTION.

As to the subject-matter of the address, Mr. Jones set out to interest his hearers first of all in what are the modern developments in gas practice; and then in how far this practice has been making itself useful during the war, what fresh prospects it has in the coming time of peace, and, finally, what is the special qualification of the gas engineer, and what is the work he has to do. There has, he pointed out, come about in the work of the gas engineer an entire revolution, inasmuch as the use of gas for direct lighting has become almost extinct, and there has been an enormous development of gas as pure fuel, both for domestic and trade purposes, as well as for motor-cars. This extension has been brought about largely by the reduction in the price of gas—a reduction which has stimulated the employment of engines, furnaces, and countless heating appliances for the metal trade. As to the prepayment meter system, he declared that in the London district from 70 to 80 p.ct. of the consumers are working people using automatic meters; and they take upwards of 35 p.ct. of the total output. In the large Provincial towns, the figures are rather smaller. About 40 p.ct. are slot-consumers; and they now take more than 20 p.ct. of the gas consumed. These figures are rapidly growing.

To show what is being done with gas-furnaces, the President pointed out that in the East of London the Royal Mint melt the whole of the coinage by this means; and at Messrs. Rothschild's large refinery also gas is used for smelting. The gas company who furnish this supply have, by their own gas-furnaces, melted metal with such good effect as to produce an alloy so superior that the company have been asked to melt metals on a large scale for the Munitions Department, which work is being done entirely by women. Sir Robert Hadfield uses in his Sheffield works 500 million c.ft. of gas per annum for smelting and metallurgical purposes; and Mr. Hanbury Thomas, the General Manager of the Sheffield Gas Company, states that in his district there are at work 642 furnaces, consuming about 372 million c.ft. of gas, while 15,116 H.P. in gas-engines consume 789 million c.ft. From Birmingham, Manchester, Glasgow—and, indeed, from all the manufacturing towns—there are similar reports. An important result of these extended uses of gas appliances has been their ready applicability to the rapid furnishing of munitions.

THE INDUSTRY AND THE WAR.

Coming to the part played by the gas industry in the provision of high explosive material for the war, Mr. Jones said he had obtained Lord Moulton's permission to quote to the members the full and generous recognition to this service which Lord Moulton gave at the last [June] meeting of the Institution of Gas Engineers.

Coming from such an authority, the industry could not possibly look for a higher encomium. The explanation of Lord Moulton's graceful acknowledgment was that, at the time the appeal for assistance was made, there was in the hands of the gas engineer neither a process nor plant for the recovery of one special requirement; but Mr. Charles Carpenter, D.Sc., found a means by which the greater part of the recovery could be effected at once, and within a fortnight some of them began to "deliver the goods." To meet the large demands, there has since been installed on most large-scale works more complete plant for the work; but no profit at all is obtained from this. In addition, the service of the chiefs of the staff for organizing the co-operation of all gas undertakings in this work has been given by the gas companies without charge; and many other accommodations have been gratuitously afforded. There is an impression that because of the war a great deal of money has been made by the gas industry; but this is not really the fact.

IN TIMES OF PEACE.

In the next portion of the address, consideration was given to the question of how far the various processes now in vogue will help in future times of peace. The value of coke and ammonia was touched upon; and then the President came to perhaps the more fascinating topic of tar. The sub-products of tar, he said, can for simplicity be shortly grouped into ten products which, by their energetic combustion, are capable of explosion for war or motor fuel, nineteen colour dyes of great brilliancy, nine drugs and antiseptics, eight perfumes and flavourings, ten salts of ammonia and cyanogen, and one sulphur for acid-making and fixing ammonia and cyanogen. This makes a total of 57; and these may be brought out by further permutations into an almost endless number of products. When the full value of these products is realized under peace conditions, steps must be taken to prevent—as has long been done in Germany—the inevitable loss of these values where raw coal is burned to destruction, as in ordinary grates and furnaces under steam-boilers. To this end, there are important inquiries going on into the question of the conservation of coal as a national asset. Through the extended use of gas, already a very large amount of coal has now been displaced for domestic and trade use, to the great improvement of the atmosphere and the cleanliness of buildings.

THE PROBLEMS OF THE GAS ENGINEER.

Having thus shown the useful service already being discharged by gas undertakings, Mr. Jones proceeded to sketch briefly the responsibilities and the problems shouldered by the gas engineer. He told his audience that, exclusive of the important services which producer gas performs, the coal-gas service is represented by the members of the Institution of Gas Engineers (of which Lord Moulton is President this year). The Institution has 730 members and 113 associate members, of whom 90 are members of the Institution of Civil Engineers. They administer 831 gas undertakings, which, according to the last available Board of Trade returns, employed a capital of £140,000,000, carbonized 19 million tons of coal and equivalents, and distributed2 06,500 million c.ft. of gas through a system of 40,000 miles of mains, for the service of some 7,103,113 consumers, who thus appeared to have taken something under 30,000 c.ft. of gas each in the year; there being a consumption per mile of main of about 5,200,000 c.ft. The net receipts of this large business came to slightly over 5 p.ct. on the capital involved; so it can hardly be considered a profiteering business in any shape or form. Allusion was made to the sliding-scale and to the profit-sharing system, and their attention was drawn to the remarkable fact that, in spite of the price of coals and labour during the last ten or twelve years having been rapidly increasing, the price of gas has materially fallen—due chiefly to the change in use from light to heat. Something like 1s. per 1000 c.ft. is the reduction in some of the larger towns, down to 7d. in the smaller ones. This is the average for the past twenty years, during which time the entire business has doubled in volume, and the amount of capital has also doubled.

As to the work of the gas engineer, he felt it his duty to call attention to the fact that there are some very important engineering works falling to the lot of the constructing engineer. Perhaps the most difficult task confronting him will be in dealing with the deep tanks for their gasholders. These to-day reach such large volumes that they cannot be economically carried out except in masonry or concrete. They require foundations of great depth, where the necessary excavations have often to be carried out under a very heavy head of water, and may penetrate through comparatively sound strata into more treacherous substrata, involving heavier pumping than any other part of the works. If the site of the works should be—as mostly occurs in large works—on the banks of a navigable river or near the sea, the engineer will have to work in tidal waters for embankments, wharf walls, and jetties for unloading coal, all of which will give him difficult foundation work.

A special illustration of such difficulties was the groyning work protecting the Portslade Gas-Works from violent seas in heavy gales. There the groyning was specially ingenious and effective, due to the work of the late Mr. J. B. Paddon. Another example is at Eastbourne, where at the works there is a depth of 40 ft. from mean high-water level; and there was found the bed of an ancient river, with seashells and running sand. The original motive for telescopic gasholders was the avoidance of the costly work on the deeper tanks found necessary for the larger storage as gas-works developed in size. Sir George Livesey, at the Greenwich works of his Company, was led by the discovery of less stable strata at the greater depth, to reduce the depth of his then largest tank, and to increase the telescoping to five lifts for his 8 million c.ft. holder—at that time by far the largest ever attempted. But this is a comparatively dangerous thing to do, because if one diminishes the vertical distance between guiding-rollers as compared with the horizontal, there is great liability to dip under wind pressure or side loading by snow drift on the crown, causing jamming. The safe construction and maintenance under storms of holders, which offer large surfaces to wind pressures, also demand special and careful study, having regard to their position.

As to the buildings enclosing the retorts and other plant, they must be protected from the smallest movement or settlement, which would destroy the settings by cracking the fire-brick flues and retorts. These retorts are now almost universally heated by gaseous fuel from coke generated on the principle introduced in the sixties by the Siemens family, and very much developed by Mr. Charles Hunt and other workers. All buildings should be fire-proof, and some of them should be as far as possible explosion-proof. While the bulk of the plant and the lesser buildings present no special difficulties, the erection of jetties and viaducts, trams and railways, with the mechanical equipment of cranage and machinery for conveying, lifting, stowing, charging, and discharging, in the carbonizing and purifying sections, the laying-out of gas and steam power with hydraulic, compressed air, or electric transmission, all demand good mechanical experience and care in planning to secure economical efficiency in labour saving. Further, to-day the gas engineer must be familiar with the plant necessary for the primary separation of the simpler products of the residuals. He may have to construct such abnormal things as acid works and tar works.

In the distribution system, there is the establishment of arterial distributing mains, involving frequently dimensions of 3 ft. to 4 ft. in diameter, and their execution in main roads and streets of narrow proportions already occupied by tramways, sewers and drains, water mains and services, electric light mains and services, telephone and telegraph wires, and frequently intersected with railway and canal bridges and viaducts. This will require, perhaps, no great inventiveness, but certainly a large amount of study and careful provision in which mechanical skill and experience are necessary.

Mr. Jones concluded his address by taking a brief glance at the future of the engineering profession generally, referring to the burden of replacement which will be put upon it by the destruction the war is causing. This loss makes it obvious that there will be no lack of employment for labour or for those who will have to direct this labour. To the young engineer, he said: "Whatever branch you may belong to, in approaching the work of your life you should avail yourself of the opportunities presented by such Institutions as are provided by your own special branch; but you should not be content to confine yourself altogether to your own groove, but should seek a wider outlook. Too much stress cannot be laid on the necessity of workshop training in mechanical principles, which essentially form the sure foundation for all engineering works whatsoever. The handling of tools, the constant association with workshop operations and practices, instil a familiarity which becomes almost second nature. They give facility of comprehension and expression to the designer, a command of methods and of equivalent forms of action and construction, that cannot be over-valued. But the young engineer, of whatever branch, should finally seek the broader circle of observation and record afforded by this Institution, which spreads itself so widely as to comprehend all branches of engineering. Perhaps the best influence of such an Institution is the subjective effect on the member's own character, by inspiring a higher professional ideal. No one unmoved can follow the history of the Institution over the century, or study the careers of the past leaders of the profession, without being filled with reverence for their strenuous genius and for their stupendous works. That their spirit survives in the Institution to-day, and is at the nation's call, is shown by the rallying to arms of no less than 2700 members and students. Of these, 214 have won decorations for devotion and valour on the battlefield, and must receive our proud congratulations. Alas, 228 have died for their country's protection. Their glorious sacrifice will be ever enshrined in our hearts, and their memories be imperishably preserved on our Roll of Honour."

Economics of Coal Production.—At a meeting of the London Section of the Society of Chemical Industry on Monday, the 3rd prox., the President of the Society, Prof. Henry Louis, D.Sc., will give an address on this subject.

Peat in Gas Making.—The utilization of peat as an industrial fuel and in gas making is the subject of a lengthy review in the current issue of the "Journal des Usines à Gaz." For the information of its readers, many of whom have a present interest in the carbonization of peat, particulars are given of deposits of the material, its collection, and composition. The major portion of the text is devoted to the use of peat in gas-producers, for which purpose, as also for the production of sulphate of ammonia or methyl alcohol, the French authorities are prepared to admit a post-war future for peat. For the manufacture of town gas, on the other hand, the facts do not justify any hope of its economic success. The practical trials—at the experimental works of the Paris Gas Company at Villette—on which this latter judgment is based, are to be described at length in a succeeding issue of our contemporary.

ELECTRICITY SUPPLY MEMORANDA.

THE future of electricity supply in this country appears at the present time to be screened in a sort of triangular enclosure—one side being supplied by the Board of Trade Electric Power Supply Committee, the second by the Board of Fuel Research, the third by the Sub-Committee of the Reconstruction Committee who have also been considering the subject of electricity supply. The first and the last-named Committees are satisfied that the coming industrial requirements of the country will include a large amount of cheap electric power; and the Board of Fuel Research are of opinion that care must be taken as to the manner of generating the heat required at the initial part of the electricity producing system, or uneconomy instead of economy may result. This is an open question that can only be settled by research. But whatever the decisions and the final issue therefrom, the larger corporations are discussing, or actually taking in hand, considerable schemes of extensions, involving, so we are informed by one authority, the spending of several millions of pounds. Manchester, Bradford, Sheffield, Birmingham, Leeds, Glasgow, Edinburgh, and Rotherham may be cited. But, of course, their proposals are subject to ratification by the Local Government Board, and the consent of the Treasury; and these central authorities, under prevailing circumstances, firmly exercise their veto at the point where they conceive the present needs for munition purposes will be adequately served. This may delay the greater part of the large spendings sufficiently long to make these schemes subject to whatever may be done nationally. However, the projects would not have been brought to the position at which they could be at once launched subject to loan sanctions, if those responsible for them were not satisfied that there were going to be big developments in demand. Optimism is not always a guarantee of realization. Confidence and ideas may be too inflated. Some electrical engineers are a little uncertain as to how far they are justified in allowing their expectations to roam. The platform from which they are examining the future has a sub-structure composed of abnormal circumstances. The electrical demands of war time in industrial areas have been of such a plethoric order that these engineers are doubtful as to how much of this may be regarded as permanent business, and how much will dwindle away, and leave them with a good margin of generating capacity for which new business will have to be found. In such an event, some of the extensions that have been projected may be discovered to be on too liberal a scale.

Schemes and Optimism.

A Speculative Outlook.

Leeds is contemplating large extensions, supplementing previous ones, which form part of a scheme involving some hundreds of thousands of pounds. The Electrical Engineer (Mr. C. Nelson Hefford) has made a careful survey of the position, to ascertain how much of the scheme must be carried out, and how much can be deferred, and be subject to any decision of the tribunals that are investigating questions that may profoundly affect electricity generating policy. Considerable interest attaches to the report, in view of its general application. Mr. Hefford makes no secret of his opinion that it is a matter of speculation as to the extent to which the demand that has arisen for munition purposes will be permanent; but at the same time he is optimistic. He separates Leeds from the rest; for in its case, it seems, there is reason for congratulation in that so far the electricity undertaking has not been subjected to the installing of additional plant to meet any extraordinary demand arising purely out of the war. Indeed, very few works have been erected in the city solely for munition purposes; and there is no reason, so he thinks, to anticipate any general reduction of demand, if the trade of the country is maintained, when the factories once more take up their pre-war manufactures. The works that have been specially constructed are all of a permanent character, and adjacent to pre-existing ones, with a view to their ultimate use as engineering workshops. Admittedly, the war has given an impetus to the use of electricity for industrial power; and therefore, on all grounds, Mr. Hefford is satisfied that progress in this line is well assured. This is the view of most electrical engineers in industrial centres with their knowledge of local conditions. In regard to the expansion of the domestic business, they are on more uncertain ground. Here we have Mr. Hefford saying: "It must be remembered that a large amount of domestic load is available which is likely to be connected as soon as existing restrictions are removed." The "likely" does not denote a very secure foundation for confidence. On the other hand, it is stated that a considerable number (which is also indefinite) of applications for such supply have had to be refused by the department, and are simply deferred. Very great progress, too, we are informed, has been made in the design of domestic appliances requiring electricity for their operation; and "there is little doubt" that a very great increase in demand will accrue from this source, as during the war domestic apparatus has been almost unobtainable. So on the whole Mr. Hefford does not think it will be prudent to conclude that the average increase of load in Leeds during the next few years will be less than 3500 KW. per annum; and, indeed, he considers this is likely to be rather an under-estimate than the reverse. It will have been noticed that in regard to the increase of domestic consumption (we take it reference is made more especially to heating and cooking apparatus), Mr. Hefford is careful to use qualifying terms which will be very handy in the event of disappointing results necessitating a retreat from the optimism with which he evidently desires at the present time to inspire his Committee. We would suggest that he should consider the value in heat units that the gas industry gives to the domestic consumer for money expended, and the fact that in these times the gas industry is not standing still in investigating possible gas-producing economies which will redound to the advantage of the domestic as well as of the industrial user—in the latter case for both heat and power. It is as well to examine the position from all possible points of view rather than select any single aspect for optimism.

The Burdensome Half-a-Crown.

Each week notices are seen of further increases of prices for electricity, owing, this time, to the additional 2s. 6d. per ton that the Coal Controller has thought fit to award the colliery owners to counterbalance the advance conceded to the miners and the boys, and which 2s. 6d. per ton has a munificence about it that large buyers of coal consider is unwarranted. Another feature of the matter (against which the "JOURNAL" has made protest) is the retrospective incidence of the increase. This is bad for the gas and electricity industries, though only proportionately, and not equally in round numbers. It is impossible to impose a retrospective charge upon gas and electricity consumers, or to ask them to pay an increased price without giving them due notice. The Bradford Corporation Electricity Committee have, therefore, lodged a protest against the retrospective application of the increase to Sept. 17, and have urged the Coal Controller that works should be brought into line with contracts for coal for household purposes, which would reduce the retrospective application of the increase to Oct. 15. We are afraid the protest will be in vain. The Glasgow Corporation Electricity Committee state that in their case the additional expenditure for fuel for the current year, owing to the extra 2s. 6d., will be £25,000; and it has been decided to increase the charges for all purposes by 0·075d. per unit. This £25,000 is small, compared with what the Gas Department will have to pay. It was lately mentioned that the Corporation Gas Committee had contracted for 820,000 tons of coal for the current year; and 2s. 6d. on this quantity would be £102,500. Taking the whole gas industry, the extra 2s. 6d. means an addition to the coal bill of, approximately, £2,250,000, while in the case of the electricity supply industry, it is only a quarter of the sum, or £562,500.

A New Excuse for Converting Street Lamps.

Some of the electricity departments of local authorities are trying to improve their street-lighting status at the expense of gas while enemy raiders, and the possibility of a visit from them, afford the excuse. Eastbourne is a case in point. It is reported that, in order to meet the demand for more light, and, to ensure prompt extinction in emergency, the Corporation have decided to convert the gas-lamps into electric-lamps along the main streets. A report from Bristol, too, states that, as electric-lamps can be extinguished within "fifteen minutes" of warning being given, the Council have authorized the introduction of improved street lighting at once. This "concession," it is significantly added, does not apply to the gas-lamps. Some local governing authorities have never heard of the pressure-wave system of controlling public gas-lamps, which provides for ignition and extinction without any loss of time.

Electric Troubles in London.

Electricity supply did not enhance its reputation last week in London. On Thursday evening a large part of the West-end was without current for about two hours. Shops had to be closed, and industrial establishments had to stand idle—including, we understand, certain printing establishments. It was the period when preparations were going forward for dinner. We wonder whether any of those much-advertised electrical cooking equipments came in for this *coup de main*. The Southern District Association of Gas Engineers and Managers were enjoying the hospitality of the Royal Society of Arts for their autumn meeting when the collapse occurred; but the inverted-burner ventilating lamp was brought into use, and the meeting proceeded with but the slightest interruption. Of course, no one present was guilty of making any disparaging or sarcastic remarks regarding the fickle rival. Early the same day there was an explosion in Little Earl Street, Seven Dials, which caused injury to three firemen and some unfortunate pedestrians. It was due to the fusion of an electric cable, which, according to a newspaper report, could not keep its trouble to itself, but attacked a neighbouring gas-main. The fire that resulted, it is stated, was quickly got under by members of the Fire Brigade.

Gas and Electricity Driven Motor Vehicles.

Of course, there is nothing in the use of gas for motor vehicle driving. That is why the owners of such vehicles and the gas industry are taking such an interest in the matter. It is also why the electric papers have almost a weekly and weakly gibe at it. Our revered contemporary, the "Electrical Review," thinks that the recent demonstration of

motor vehicles equipped for operation on coal gas is a striking tribute to the efficacy of a little vigorous pushing of even an undesirable thing. It lays stress upon the limited mileage that attaches to the use of coal gas for the propulsion of vehicles. This is the very point where there has been condemnation of the electric vehicle, which, however, "has never suffered from such a severe mileage handicap as the coal-gas driven vehicle apparently will." Our contemporary claims that the "fuel" for the electric vehicle is practically one-third cheaper than that of the new "hybrid." Our motor vehicle friends should be thankful. Petrol must be sold at 6d. a gallon to equal coal gas at 2s. per 1000 c.ft. or at 9d. with gas at 3s. As the electric "fuel" is "one-third cheaper" than coal gas, it would be interesting to have the one-third translated into figures for an equivalent amount of work, say with a trolley carrying a 3-ton load. The "one-third cheaper" does not explain why the electric vehicle has been so backward in adoption, and why makers have continued to fit motor vehicles, almost generally, with internal combustion engines, and not electric motors. Meanwhile, our electric contemporaries stand weeping by, filled with hatred and envy at this dawning of a fresh success for town gas. By the way, we have just noticed a quotation of £6000 for five 4-ton electric motor wagons—£1200 each!

SOUTHERN DISTRICT ASSOCIATION OF GAS ENGINEERS & MANAGERS.

THE General Meeting of the Association was held last Thursday, at the Royal Society of Arts, John Street, Adelphi, W.C. The PRESIDENT (Mr. W. N. Westlake, of Exeter) presided over a large attendance of members and professional colleagues who had specially journeyed to town to hear Mr. John West's paper, and the discussion, on economical coal carbonization.

At the commencement of the proceedings, the formal business was disposed of.

The minutes of the last meeting were first confirmed.

THE PRESIDENT OF THE "CIVILS."

The PRESIDENT remarked that a very great honour had recently been conferred upon one of the members of the Association. Mr. Harry E. Jones had been elected President of the Institution of Civil Engineers. It was an honour of which he (Mr. Westlake) was sure Mr. Jones was proud; and the members of the Association were proud of the fact that one of their old members had been elected to the position. He moved: "That the heartiest congratulations of the members of the Association be tendered to Mr. Harry E. Jones on his election as President of the Institution of Civil Engineers."

Mr. THOMAS GLOVER (Norwich) seconded the motion, and it was heartily passed.

ELECTION OF OFFICE BEARERS.

The PRESIDENT said the next business was the election of President for the ensuing year. There could be no doubt in the minds of the members what name he was going to submit. Mr. W. B Farquhar, of Ilford, had been known to the members for many years; and he (Mr. Westlake) had known him a sufficient number of years to be in a position to heartily recommend him for election as President. Mr. Farquhar was fully qualified for the office. He had filled a similar position in a sister Association; and the experience he had there gained would no doubt enable him to conduct the business probably much better than an individual who had had no similar experience.

Mr. F. DURKIN (Southampton) seconded the motion, which was cordially agreed to.

Mr. FARQUHAR said his thanks would be few, but very sincere. The position which he hoped to take up would be filled by him in the best possible way with the object of furthering the interests of the Association. They were passing through serious times, and there were more strenuous times still ahead. Nevertheless, the work of the Southern Association would always be kept in full view in his mind.

Mr. T. GLOVER proposed that Mr. A. A. Johnston, of Brentford, be elected to the position of Vice-President. It needed no words to recommend him to the members; seeing that he was Engineer of one of the progressive companies in the Metropolitan area.

Mr. A. CADDICK (Croydon) seconded the motion, which was unanimously carried.

The PRESIDENT explained that Mr. Johnston unfortunately could not be present at the meeting, owing to a bad cold.

Moved by Mr. F. W. CROSS (Lea Bridge), and seconded by Mr. C. V. BENNETT (Rochester), Mr. P. S Hoyte (Plymouth) was elected a member of the Committee.

Proposed by Mr. R. S. TOBEY (Horley), and seconded by Mr. P. P. CHANNON (Haywards Heath), Mr. W. H. Bennett (Redhill) was also elected a member of the Committee.

On the motion of Mr. FRANK LIVESEY (Maidstone), seconded by Mr. D. IRVING (Bristol), Mr. J. Wesley Whimster (Bath) was appointed a temporary member of the Committee. This, the President explained, was due to Mr. Johnston having been elected Vice-President, which made a vacancy on the Committee for one or probably two years.

Mr. W. E. PRICE (Hampton Wick) moved the re-election of the Hon. Secretary and Treasurer, Mr. H. C. Head, of Winchester—paying very high tribute to his work for the Association.

Mr. SAMUEL GLOVER (St. Helens) seconded the motion, which was heartily adopted.

The PRESIDENT spoke of the large volume of detail work that fell upon Mr. Head; and he took the opportunity of thanking him for the great assistance he had rendered to him during his (the President's) year of office.

Mr. HEAD thanked the members for their endorsement of the kind words that had been used. There was a certain amount of work to do for the Association; but anyone who received thanks in the generous terms that had been used was more than amply repaid.

Proposed by Mr. W. HIGGS (Basingstoke), and seconded by Mr. CHARLES CHAMBERS (Harrow), Mr. W. E. Price was re-elected one of the Auditors of the Association; and subsequently, on the proposition of Mr. J. FISHER (Tottenham), seconded by Mr. W. PARKER (Ryde), Mr. Andrew Dougall (Tunbridge Wells) was re-appointed Joint Auditor.

THE NATIONAL GAS COUNCIL EXECUTIVE.

The HON. SECRETARY said a letter had been received from the National Gas Council asking the Association to delegate one of the members to represent it on the Executive Committee. This invitation had been extended to all the District Associations. The Committee had that morning considered the matter, and they felt quite sure that they could not do better than recommend the election of their President (Mr. Westlake) to represent the Association.

Mr. F. W. CROSS seconded the motion, which was adopted.

The PRESIDENT thanked the members. He said he recognized that it meant a considerable amount of work; but he would do his best with the responsibilities the members showered upon him.

A BIG ADDITION TO THE MEMBERSHIP ROLL.

The PRESIDENT moved the election of the following gentlemen as members: Mr Leonard J. Langford, of Tunbridge Wells; Mr. C. S. Shapley, of Southend-on-Sea; Mr. T. S. Godwin, of Watford; Mr. J. H. Pye, of Clevedon; Mr. W. E. Caton, of Oxford; Mr. William Griffin, of Folkestone; Mr. J. R. Duff, of Banbury; Mr. S. E. Halliwell, of Bristol; Mr. E. P. Vince, of Minehead; Mr. H. C. Higgs, jun., of Basingstoke; Mr B. J. King, of Westgate-on-Sea; Mr W. E. Payne, of the South Metropolitan Gas Company, Bankside; Mr. J. G. Clark, of Newton Abbott; Mr. A. H. Solomon, of the Gaslight and Coke Company, Fulham; Mr. C. A. Cunnold, of Nine Elms; Mr. S. J. Ingram, of Truro; Mr. H. E. Riley, of St. Austell; Mr. H. H. Hoare, of Falmouth; Mr. John C. Wright, of Romford; A. W. Elton, of Littlehampton; Mr. W. J. R. Baker, of Devizes; and Mr. I. M. Brace, of Monmouth.

Mr. SAMUEL GLOVER seconded the motion, which was unanimously carried.

ECONOMICAL COAL CARBONIZATION.

Mr. JOHN WEST read a paper, entitled "Most Economical Method of Carbonizing Coal for Supplying Light, Heat, and Power by the Gas Industry and the Maximum Supply of Munitions of War." The paper, with a report of the long discussion to which it gave rise, will be found on pp. 314-25.

Tea was subsequently served in the library.

Application of Coal Gas to Industry.

A good many of the thousand-and-one uses for gas are illustrated in the November issue of the British Commercial Gas Association's periodical bearing this title; the subject specially dealt with [by means of extracts from Mr. H. M. Thornton's Royal Society of Arts paper] being the national importance of the application of coal gas to industry in war time. Thirteen of the illustrations are reproduced on this occasion; and it is stated that Mr. Thornton's paper will be concluded in the next issue. In addition to those already referred to, there are in the number now before us photographs of two interesting recent installations for the utilization of gas in industry. One of these relates to a 16-ft. gas-furnace for annealing silver rods in the production of fine strands suitable for heraldic work; while the other is of a large gas heated tank used for evaporating purposes during the manufacture of a well-known patent beverage.

Calorific Standard Applications.—The Local Government Board have received applications for Orders sanctioning a calorific power standard from the Stourbridge Town Council and the West Bromwich Town Council.

Illuminating Engineering Society.—The opening meeting of the ninth session of the Society will take place at the Royal Society of Arts, John Street, Adelphi, on Tuesday, Dec. 18, when the presidential address will be delivered by Mr. A. P. Trotter.

The Forthcoming Thomas Hawksley Lecture.—This year's Thomas Hawksley Lecture, under the auspices of the Institution of Mechanical Engineers, will be delivered by Captain H. Riall Sankey, C.B., R.E., on the 30th inst., in the meeting hall of the Institution of Civil Engineers. "Heat Engines" will be the subject of the lecture; and the time of its delivery, 6 o'clock.

Scottish Junior Gas Association (Western District).—In the course of the discussion—reported on p. 267 of last week's issue—at the opening meeting of the Association for the present session, certain remarks were attributed to Mr. John Wilson, "of Falkirk." Mr. Wilson is now Gas Engineer and Manager at Motherwell; and what he had to say was, of course, in reference to this town.

MOST ECONOMICAL METHOD OF CARBONIZING COAL FOR SUPPLYING LIGHT, HEAT, AND POWER BY THE GAS INDUSTRY AND THE MAXIMUM SUPPLY OF MUNITIONS OF WAR.

By JOHN WEST, J.P., M.Inst.C.E., M.I.Mech.E.

[A Paper read on Nov. 8, before the Southern Association of Gas Engineers and Managers.]

The war has brought about many remarkable changes in our ordinary habits and methods of working. A portion of the British gas industry is making shells and other instruments of war, while a very large proportion of the gas-making industry is manufacturing and producing large quantities of toluol and benzol and other chemical compounds for the requirements of the Government. I believe that the gas industry at the present time stands in higher estimation in the eyes of the Government, and the nation generally, than it has ever done before; and it is to be hoped that after the war is over the Government will not forget what the industry has done.

Many preparations are now being made to meet what is considered will be the best for present and future requirements of this country; and I am pleased to be able to lay before the Association the results of some experiments which have been carried out to test the economy and efficiency of certain proposed methods in the carbonization of coal. I was approached last year by a large chemical company to undertake elaborate experiments in the carbonization of coal for various chemical purposes, with a view of producing the various products as shown on the accompanying chart.

In the series of experiments, particulars of which I shall lay before you, I had the assistance of Dr. F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., Mr. John Bond, of Southport, and Mr. F. W. MacMahon, F.C.S., together with a staff of trained chemists and operators. It was decided that the question of high and low temperature carbonization should first be thrashed-out in a practical and extensive manner on a large scale, and arrangements were made to send 750 tons of Kent coal to be operated upon in a test plant consisting of four retorts of the Glover-West type. The character of this coal being unknown, we first treated it in the ordinary way at high temperatures. It was at once found that the quality of the coal did not come up to expectations. As large quantities, however, were on the way, we had to do the best we could with it; and the disappointing results are given in the following table:

TABLE I.—*Tests made with Coal of Poor Quality (Beresford Seam), containing a Large Percentage of Ash, and Carbonized at Both High and Low Temperatures.*

ANALYSIS OF COAL.

Moisture	1·95 p.ct.
Volatile matter	19·12 ,,
Ash	11·21 ,,

	High Temperature.	Low Temperature
Duration of test	4 days	4 days
Temperature taken outside retort	1400° C. = 2562° F.	978° C. = 1793° F.
Coal carbonized	43·1 tons	12·97 tons
Coal carbonized per retort in 24 hours	2·69 ,,	0·81 ,,
Total gas made, corrected to normal temperature and pressure	495,280 c.ft.	94,326 c.ft.
Gas made per ton, corrected	11,491 ,,	7272 ,,
Make of gas per retort per 24 hours	30,955 ,,	5895 ,,
Illuminating power, No. 2 Met. burner	6·33 candles	9·25 candles
Sperm value	249	230·6
Calorific value, gross	441·1	479·4
,, ,, net	395·5	428·9
Total B.Th.U. of gas made per ton of coal	5,068,680	3,486,196
Coke per ton	16·1 cwt.	15·8 cwt.
Coke made per cent.	80·7 p.ct.	79·1 p.ct.
Tar made per ton of coal carbonized (dehydrated)	6 gallons	10·89 gallons
Sulphate of ammonia made per ton of coal carbonized	14·6 lbs.	26·2 lbs.

ANALYSIS OF GAS.

CO_2	1·6 p.ct.	2·45 p.ct.
Hydrocarbons	2·5 ,,	3·10 ,,
O	0·5 ,,	0·80 ,,
CO	5·3 ,,	5·80 ,,
CH_4	38·9 ,,	37·53 ,,
H	44·2 ,,	42·83 ,,
N (by difference)	7·0 ,,	7·47 ,,

ANALYSIS OF TAR.

Specific gravity	1·051 at 60° F.	Specific gravity	1·036 at 60° F
0° to 168° C.	2·9 p.ct.	0° to 160°	5 p.ct.
168° ,, 228° C.	11·6 ,,	160° ,, 240°	16·5 ,,
228° ,, 268° C.	7·9 ,,	240° ,, 360°	27·0 ,,
		Pitch	51·5 ,,
Benzol in tar	1·53 ,,	Benzol	1·68 ,,
Toluol ,,	0·59 ,,	Toluol	0·34 ,,

Further tests were made at low temperature, averaging 978° C. (1793° Fahr.), with the results as shown in the table. I wish you to observe that with an ordinary fair gas-coal, working at high temperature, about 4 tons and upwards were passed through each retort per twenty-four hours; but on account of the low percentage of volatile matter and large percentage of ash in the Kent coal, only 2·69 tons of this coal could be passed through the retorts per 24 hours—*i.e.*, 40 p.ct. less work per retort than normally—and that a corresponding reduction took place when working at low temperatures. Comparative results are shown in the following table. Naturally, these coals were unsuitable for the purpose for which they were required.

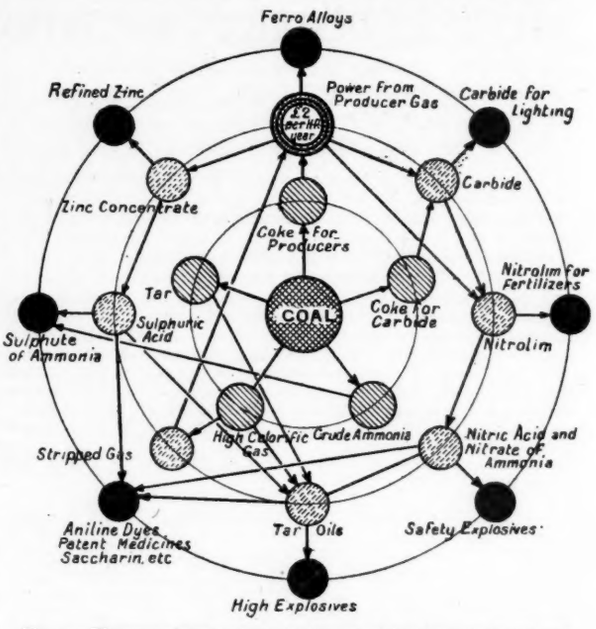

Fig. 1.—Diagram showing the Linking-up of the Bye-Products and Manufactures of the Proposed Scheme.

TABLE II.—*Test of Beresford Seam Coals.*

HIGH TEMPERATURE.

Cost per Ton.	£ s. d.	*Value per Ton.*	£ s. d.
Total cost per ton of coal	0 18 6	11,491 c.ft. gas per ton, 6·33 candles value, 249 lbs. of sperm at ½d. per lb.	0 10 4
1 ton of this inferior coal took 50 p.ct. more time to carbonize than the 4 tons normal daily output per retort. Therefore 50 p.ct. more capital, plant wear and tear, labourers' and establishment charges would be necessary to carbonize this coal against coals of good quality	0 4 6	Coke for sale produced 16 cwt., less fuel 6 = 10 cwt. at 1s.	0 10 0
		Tar produced, 6 gallons at 2d.	0 1 0
		Ammonium sulphate, 14·5 lbs. at 1d.	0 1 2½
Total cost	£1 3 0	Total value of products	£1 2 6½
Less value of products	1 2 6½		
Loss per ton of coal carbonized	£0 0 5½		

LOW TEMPERATURE.

Cost per Ton.	£ s. d.	*Value per Ton.*	£ s. d.
1 ton of coal	0 18 6	7272 c.ft. gas per ton, 9·25 candles value, 230·6 lbs. of sperm at ½d. per lb.	0 9 7
1 ton of this coal took five times longer to carbonize than the 4 tons normal daily output per retort. Therefore five times more capital, plant, and labour and establishment charges would be required to carbonize this inferior coal against coals of good quality	0 15 0	Coke for sale, 9 cwt. at 1s.	0 9 0
		Tar produced, 10·8 gallons at 2d.	0 1 9
		Ammonium sulphate, 26·2 lbs. at 1d.	0 2 2
			£1 2 6
Total cost	£1 13 6		
Less value of products	1 2 6		
Loss per ton of coal carbonized	£0 11 0		

Before any further extensive tests were carried out in the vertical retorts, it was decided that samples of the other coals obtainable should be tested on a small horizontal test plant, to determine its value. It was fortunate that this precaution was taken,

as the other coals, represented to be of good quality, turned out inferior in practice. But ultimately a coal was found which gave very fair results in the small horizontal retort test plant, with the following results:

TABLE III.—*Haigh Moor Coal.*

APRIL 13 TO 16, 1917.

Gas made per ton, corrected	11,800 c.ft.
Illuminating power	10 candles.
Sperm value	404
Calorific value (gross, 503)	457 B.Th.U. net.
Tar made per ton of coal carbonized	14·57 gallons.
Liquor ,, ,, ,,	52 gallons.
Ammonium sulphate ,, ,,	21·6 lbs.
Coke made per ton	14 cwt.
,, ,, cent.	70 p.ct. quality good.
Time of carbonizing	4½ hours.

TEMPERATURE OF CARBONIZATION.

Outside retorts	1373° C.	Average.
Inside ,, No. 1.	1048° C.	
,, ,, No. 2.	1044° C.	

TEST OF DEHYDRATED TAR.

0° to 170° C.	10 p.ct.
170° ,, 230°	15 ,,
230° ,, 360°	21 ,,
	46 p.ct.
Pitch	54 ,,
	100

About 1000 tons of this Haigh Moor coal was then tested at the St. Helens Gas-Works, and proved to be especially suitable for the Chemical Company's special requirements; the coke being of good quality for the production of carbide, on account of its low ash content. We tested this coal both at high and medium temperatures; and the results are shown in the following tables:

TABLE IV.—*Tests made with Good Coal (Haigh Moor) Carbonized in Vertical Retorts at High and Medium Temperatures.*

ANALYSIS OF COAL.

Moisture	2·29 p.ct.
Volatile matter	31·64 ,,
Ash	6·37 ,,

	High Temperature. Sixteen Days' Experiments.	Medium Temperature. Two Days' Experiments.
Temperature taken at outside of retorts	1362° C. / 2483° Fahr.	1160° C. / 2120° Fahr.
Coals carbonized	256·35 tons	17·74 tons
Coals carbonized per retort in 24 hours	4·17 ,,	2·23 ,,
Total gas made, corrected to normal temperature and pressure	3,601,796 c.ft.	237,351 c.ft.
Make per ton corrected	14,050 ,,	13,387 ,,
Make of gas per retort per 24 hours	60,011 ,,	29,685 ,,
Illuminating power No. 2 Met. burner	14·80 candles	15·60 candles
Sperm value	713	716
Calorific value, gross	556	567·7
,, ,, net	504	522·6
Total B.Th.U. of gas made per ton of coal	7,811,800	7,733,669
Coke per ton	13·57 cwt.	—
Coke made per cent.	67·8 p.ct.	—
Tar made per ton of coal carbonized (dehydrated)	16·06 gallons	16·5 gallons
Sulphate of ammonia made per ton of coal carbonized	23·6 lbs.	26 lbs.

ANALYSIS OF GAS.

CO_2	2·0 p.ct.	2·9 p.ct.
Hydrocarbons	3·0 ,,	3·3 ,,
O	·9 ,,	1·0 ,,
CO	6·1 ,,	6·6 ,,
CH_4	26·4 ,,	27·31 ,,
H	52·8 ,,	50·64 ,,
N	8·8 ,,	8·25 ,,

TAR.

Specific gravity	1·143	1·072
Distillate, 0° to 170°	3·14 p.ct.	4·6 p.ct.
,, 170° to 230°	19·67 ,,	21·1 ,,
,, 230° to 360°	32·97 ,,	31·4 ,,
Residue, pitch by difference	44·22 ,,	42·9 ,,

Upon the results of these coals, Dr. Perkin and myself advised the Chemical Company to purchase the collieries, which they have now done.

Dr. Perkin decided not to proceed with any tests at lower temperatures, as the output was so seriously reduced that it would not pay commercially. We therefore expressed the results in £ *s. d.*, as shown in the following table, which is self-explanatory:

TABLE V.—*Haigh Moor Coal.*

HIGH TEMPERATURE.

Cost per Ton.	£ s. d.	*Value per Ton.*	£ s. d.
1 ton of coal	1 1 0	14,050 c.ft. gas per ton, 6·33 candles value, 713 lbs. of sperm at ½d. per lb.	1 9 8
Capital, wear and tear, labour, and establishment charges	0 3 0	Coke, 11 cwt. at 1s.	0 11 0
		Tar, 16·06 gallons.	0 2 7
		Liquor=23·6 lbs. of ammonium sulphate	0 1 11
Total cost	£1 4 0	Total value	2 5 2
		Less cost	1 4 0
		Total profit per ton of coal carbonized	£1 1 2

MEDIUM TEMPERATURE.

Cost per Ton.	£ s. d.	*Value per Ton.*	£ s. d.
1 ton of coal	1 1 0	13,387 c.ft. gas per ton, 15·60 candles value, 716 lbs. sperm at ½d. per lb.	1 9 10
Double the time taken to carbonize 1 ton of coal over high temperatures. Therefore, double the capital, plant, wear and tear, labour, and establishment charges would be required. Charges on capital and plant, wear and tear, labour, and establishment charges	0 6 0	Coke for sale at 1s. per cwt., 11 cwt.	0 11 0
		Tar, 16·5 gallons at 1½d.	0 2 4
		Liquor=26 lbs. of ammonium sulphate	0 2 2
		Total value	2 5 4
		Less cost	1 7 0
Total cost	£1 7 0		£0 18 4
		High temperature, profit per ton	1 1 2
		Medium temperature, profit per ton	0 18 4
		Loss per ton on medium temperature carbonization	0 2 10

While these experiments were going on, Dr. Perkin conceived the idea of passing stripped gas back through the retort, which he believed would conduce to an increase of tar and other liquid products. For this purpose, pipes were introduced into the coke-chamber at the bottom of the retorts; so that the gas, after having been stripped of its benzol and toluol, would pass upwards through the charge in the retort. The anticipated results were obtained, and the tar was increased by some 2 to 3 gallons per ton of coal carbonized, and the volatile matter in the coke was practically reduced to zero; the make of gas per ton being slightly increased. It was part of the scheme to strip the gas as far as possible of its condensible constituents, and to utilize the gas for heating the retorts in lieu of coke—the surplus gas to be used for power purposes about the works. It will interest you to know that, after we had stripped the gas of its illuminants, it remained of a very good calorific value, and was never below 450 B.Th.U. This gas is of considerable value for heating and power purposes in general.

I should say that all the various samples of tar were taken in large quantities in tank wagons to Southport, where they were distilled in a large modern tar-distilling plant that had been recently erected. The Company will first build works, and use up all the bye-products; and they also intend to erect other works especially to take out the bye-products, and then sell the gas cheaply for electric and other power purposes. It has occurred to me that, although the objects which the Chemical Company have in view are not strictly the same as those for which gas undertakings exist, still from these considerations some suggestions may arise which will tend to increase the efficiency of gas undertakings generally; and as undoubtedly a larger number of bye-products will be required in the future, especially in connection with the British dye industry and fertilizers, such as sulphate of ammonia, we may be called upon to make radical changes in our methods of carbonization.

In my younger days, gas engineers were all low-temperature carbonizers, simply because we could not get high temperatures with the ordinary furnaces then in use. In those days, we produced about 9000 c.ft. of gas to the ton of coal carbonized, with a small quantity of tar and ammoniacal liquor; but after the regenerator principle came into operation, we at once, with considerable advantages, increased our heats and produced a larger volume of gas, tar, and ammoniacal liquor per ton. In the late Mr. Newbigging's "Handbook" for 1885, he gave the quantities of gas, tar, and ammoniacal liquor produced at that period, as follows:

Wigan Cannel and Coal.

Yield on an Average per Ton.

	Cannel.	Coal.
Gas	10,900 c.ft.	9980 c.ft.
Illuminating power	24 sperm candles	15 sperm candles
Coke	1436 lbs.	1517 lbs.
Tar	17 gallons	11 gallons
Ammoniacal liquor	18 gallons	20 gallons

Newcastle Coal.

Yield on an Average per Ton.

Gas	9700 c.ft.
Illuminating power	15 sperm candles
Coke	1540 lbs.
Tar	9 gallons
Ammoniacal liquor	10 gallons

Dr. Colman, some few years ago, made several tests with both these kinds of coal in the Glover-West vertical retorts at ordinary temperatures at St. Helens, with the following average results for tar and ammoniacal liquor:

Wigan Arley Mine Coal.

Tar	13·2 gallons
Ammoniacal liquor	32·6 gallons at 10 oz.

Newcastle Coal.

Tar	12.3 gallons
Ammoniacal liquor	31·1 gallons at 10 oz.

The object of this table is to show that the tar and liquor remain about the same with either high or medium temperatures.

The reason for this is quite obvious. The temperatures in former times were not high enough to remove the whole of the valuable liquid products, and these were left in the coke which was not fully carbonized. The coke was friable, and something like the coalite specimens that there is so much talk about at the present time.

Summary of the Advantages and Disadvantages of Carbonizing Coals at High, Medium, and Low Temperatures.

Advantages of High Temperatures.	Disadvantages of Medium and Low Temperatures.
1.—Requires less ground area for buildings.	Requires double and treble ground area.
2.—Requires less carbonizing plant.	Requires double and treble carbonizing plant.
3.—Requires less capital.	Requires double and treble more capital.
4.—Requires less labour.	Requires double and treble more labour per ton.
5.—Make very considerably more gas per ton of coal.	Make of gas reduced less than half per ton.
6.—Gas of higher calorific value when all illuminants removed.	Gas of low calorific value when illuminants removed.
7.—Better and harder coke.	Coke badly carbonized and very friable, resulting in considerable waste.
8.—Tar and liquor by our special means not reduced and of better quality for war work.	Coke or coalite contains after carbonization considerable quantity of products which are wasted.
	Double and treble the quantity of coals unnecessary and wastefully used in working this process which results in a huge national loss. Consequently, it is a retrograde system and behind the times.

The results of some further experiments I have the pleasure to bring before you were made for purely gas-making purposes. The chief object in these experiments was to ascertain the extent to which steam can be admitted at the bottom of the retort for the purpose of generating blue water gas and the increase in the make of gas per ton of coal carbonized without unduly reducing its calorific value. These tests were carried out in the same experimental plant, the vertical retorts in which are of special silica material built-up in segments; and it was found that higher temperatures could be maintained than formerly. The retorts are also of slightly larger section than those in general use. In order to obtain comparative results, it was decided to use similar coals to those which had been previously carbonized, and of which the results had been tabulated upon tests in the ordinary way. The following table shows the results with and without steam:

ORRELL NUTS.

The following tests were made for gas-making purposes in the ordinary way and afterwards by steaming.

These excellent results were obtained from the above coal in a five days' test at high temperatures and for the following two days steam was admitted into the coke chamber at the bottom of the retorts for the purpose of making blue water gas, as follows:

TABLE VI.

	High Temperatures. Five Days' Experiments.	High Temperatures. Two Days' Steaming to make Blue Water Gas. 25 lbs. Pressure through ½-in. Nozzle.
Temperature outside retorts, average	1393° C. / 2539° Fahr.	1397° C. / 2547° Fahr.
Coal carbonized	77·70 tons	34·03 tons
Coal carbonized per retort in 24 hours	3·88 tons	4·25 tons
Total gas made, corrected to normal temperature and pressure	1,094,323 c.ft.	527,018 c.ft.
Make of gas per retort per 24 hours	54,716 ,,	65,877 ,,
Make of gas per ton, corrected	14,084 ,,	15,487 ,,
Illuminating power, No. 2 Met. burner	11·16 candles	8 69 candles
Sperm value	539 lbs.	461 lbs.
Calorific value, gross	522 B.Th.U.	506 B.Th.U.
,, ,, net	475 ,,	460 ,,
Total B.Th.U. of gas made per ton of coal	7,351,848	7,836,422
Tar made per ton of coal carbonized (dehydrated)	16·8 gallons	17·7 gallons
Ammoniacal liquor, 10 oz., per ton of coal carbonized	33·3 ,,	32·6 ,,

ANALYSIS OF GAS.

CO_2	1 9	3·3
Hydrocarbons	2·6	2·2
O	·3	·2
CO	12·0	16·2
CH_4	26·1	20·7
H	51·6	51·9
N	5·5	5·5

TEST OF DEHYDRATED TAR.

Specific gravity	1089 at 15° C.	1·0905 at 15° C.
0° to 170° C.	1·50 p.ct.	2·5 p.ct.
170° to 230° C.	15·75 ,,	13·5 ,,
230° to 360° C.	36·00 ,,	37·0 ,,
Residue	46·75 ,,	47·0 ,,

TABLE VII.—ORRELL NUTS (*continued*).

	High Temperatures. Two Days' Experiments Steaming to Make Blue Water Gas 40 lbs. Pressure ½-in. Nozzle.	High Temperatures. Two Days' Experiments Steaming to Make Blue Water Gas 45 lbs. Pressure ½-in. Nozzle.
Temperature outside retort, average	1387° C. / 2529° Fahr.	1415° C. / 2579° Fahr.
Coals carbonized	31·92 tons	28·50 tons
Coal carbonized per retort in 24 hours	3·99 tons	3·56 tons
Total make of gas, corrected to normal temperature and pressure	530,126 c.ft.	497,624 c.ft.
Make per ton, corrected	16,607 ,,	17,460 ,,
Make per retort per 24 hours	66,265 ,,	62,203 ,,
Illuminating power, No. 2 Met. burner	8·34 candles	—
Sperm value per ton	475 lbs.	—
Calorific value, gross	505 B.Th.U.	494 B.Th.U.
,, ,, net	459 ,,	443 ,,
Total B.Th.U. of gas made per ton of coal	8,386,030	8,625,734
Coke per ton	13 cwt.	—
Coke made p.ct.	74·8 p.ct.	—
Tar made per ton of coal carbonized (dehydrated)	20·0 gallons	17·8 gallons
Ammoniacal liquor, 10 oz.	43·9 ,,	—

ANALYSIS OF GAS.

CO_2	3·7	3·5
Hydrocarbons	2·2	2·1
O	·3	·3
CO	17·1	21·4
CH_4	20·8	18·8
H	51 2	50·8
N	4·7	3·1

TEST OF DEHYDRATED TAR.

Specific gravity	1·0146 at 15° C.	1·0665 at 15° C.
0° to 170° C.	1·5 p.ct.	2·0 p.ct.
170° to 230° C.	13·5 ,,	10·0 ,,
230° to 360° C.	39·5 ,,	44·0 ,,
Residue	45·5 ,,	44·0 ,,

Steaming in vertical retorts of this type is no new thing. It has been in general practice in several works for some time past. I confess at the outset that I shared the general apprehension that steaming might result in damage to the retort. Experience, however, has proved that this apprehension is unfounded, in spite of the fact that in ordinary water-gas generators there is considerable wear and tear on the fire-brick lining. In the Glover-West system, a small jet of steam of 5 to 8 lbs. pressure to the coke chambers has always been arranged for the purpose of preventing the gas from igniting in the coke chambers when the mouthpieces are open for discharge. The adoption of the calorific standard has increased the possibilities of steaming.

There is a distinct difference between the production of blue water gas in the ordinary generator, where the steam is forced in intermittently in a wet state and at high pressure between the coke and the sides of the fire-brick lining, and the continuous introduction of low-pressure steam to the vertical retorts. In the former case, owing to the introduction of air, clinker is formed on the sides of the producer. The clinker has to be removed by means of clinkering tools, involving wear and tear to the brickwork. In the latter case, steam is admitted to the coke chambers at the bottom of the retort through a small nozzle which takes a very small volume of steam compared with the water-gas plant. This steam passes upwards slowly and gradually through the coke as the latter descends through the extractors. The coke first absorbs all the moisture, and afterwards the steam is superheated, and therefore quite dry, before it enters the retort proper, where it is converted into blue water gas by the reactions which take place in the heated coke in the bottom part of the retort.

This ideal and valuable generator was not designed for the purpose for which it is now so successfully used; but it does not cost anything extra to instal. All one has to do is to turn the steam on at 25 to 40 lbs. pressure, and the make of gas is increased by about 2500 c.ft. per ton of coal carbonized at a very small extra cost for coke and steam. The total output by this means can be increased by 20 to 25 p.ct. with the same retort, as will be seen by the results I have laid before you. The quantity of steam introduced was so regulated that the calorific power of the gas did not fall below 500 B.Th.U.

There is a great difference between the mixing of the blue water gas with the ordinary coal gas, which is generally admitted and mixed in some part of the plant, and the way the steam is admitted direct into the vertical retorts. In the former case, there are two separate plants in operation, and the blue water gas has no influence upon the carbonization of the coal; whereas by the addition of the small volume of steam injected continuously into the body of the incandescent coke in the vertical retorts during carbonization, a very important part is played by the blue water gas, which no doubt causes several reactions to take place with the volatile matter contained in the coal, and which tends very materially to liberate more of the hydrocarbons which were formerly left in the coke. This, no doubt, is the reason why more gas, tar, and liquor is produced, and the high calorific power of the gas maintained.

I am inclined to think that, with a nozzle of (say) ⅛ in. diameter, it is advisable to keep the steam pressure to 40 lbs., although, of course, it is necessary to be guided by experiments with the various kinds of coals being carbonized.

Mr. Hislop, of Uddingston, and Mr. Tallentire, of Lurgan, have placed at my disposal the results of their continuous working

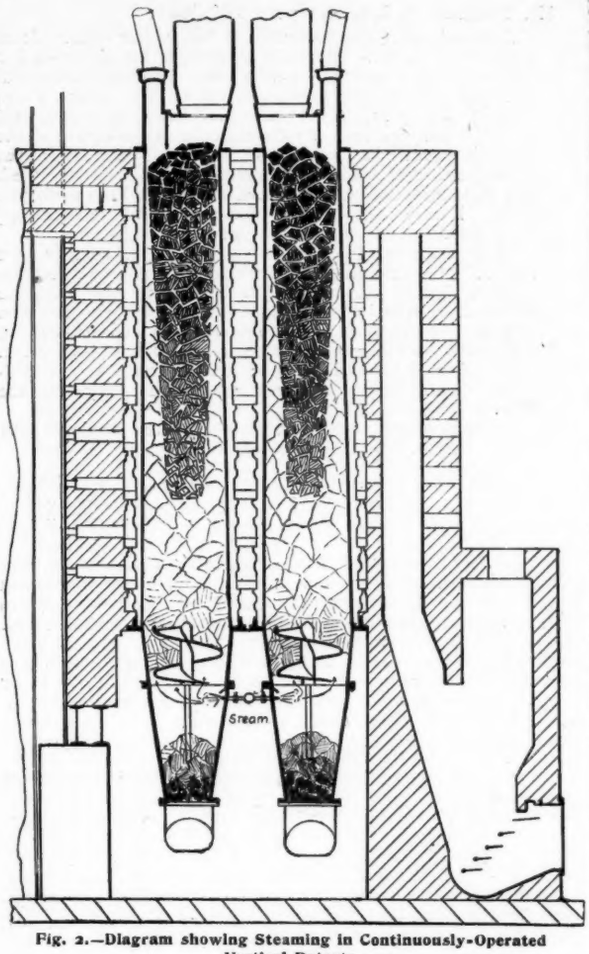

Fig. 2.—Diagram showing Steaming in Continuously-Operated Vertical Retorts.

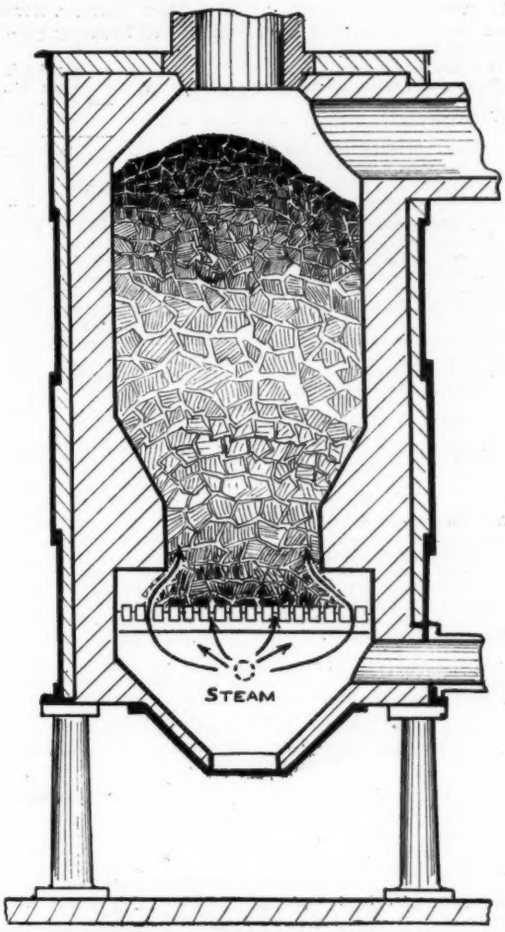

Fig. 3.—Diagram showing the Introduction of Steam to a Water-Gas Generator.

on these lines, and have supplied me with some most valuable statistics of working over a long period. The following are complete particulars I have received from Mr. Lawrence Hislop, of Uddingston. In submitting for your information the working results which he has obtained under various methods and conditions of working since the Glover-West plant was put into operation in November, 1914, he reports as follows:

> My greatest difficulty with steaming has been to keep-down the percentage of CO_2 to a reasonable amount; but I have now managed to increase the heats in the lower sections of the retorts sufficient to give (with steaming) a make of nearly 18,000 c.ft. of gas per ton containing under 4 p.ct. of CO_2, and I believe that better results could be obtained if we did not require to utilize some of the heat of the coke for heating the secondary air before going into the setting.
>
> Since May 21 last, one setting of eight retorts has been wholly heated by town gas (unpurified), giving a better and much more uniform heat in the setting using town gas than I have ever been able to get from the producer, probably owing to the quality of the gas and the rate of flow remaining constant in comparison with the variations in quality, and rate of flow of producer gas from the producer, owing to clinkering, &c.
>
> The retorts on which these results have been obtained have been in constant use since Nov. 19, 1914. They are in splendid condition, both as to shape and freedom from cracks; and, judging from their present condition, they should not need any repairs or renewal for years to come.
>
> *Re* toluol and benzol, I have been oil-washing since Feb. 20, and have sold over 2 gallons per ton of coal carbonized of crude benzol, giving about 50 p.ct. at 120° C., but containing a large quantity of paraffins.

TABLE VIII.—*Uddingston Gas-Works.*

Coal Used—Lanarkshire Washed Nuts.

RESULTS OBTAINED IN HORIZONTAL RETORTS.

Gas made per ton of coal	9670 c.ft.
Gas sold per ton of coal	9294 c.ft.
Average (gross) calorific power	600 to 620 B.Th.U.
Coke sold per ton of coal (containing 20 to 25 p.ct. of moisture)	10·41 cwt.
Coke (dry) in coal by laboratory analysis	10·4 cwt.
Tar sold per ton of coal	10·65 gallons
Sulphate of ammonia sold per ton of coal	26·46 lbs.

RESULTS OBTAINED IN EIGHT GLOVER-WEST VERTICAL RETORTS

With normal steaming—*i.e.*, 5 to 6 lbs. steam on $\frac{1}{10}$-in. nozzles—as per test of plant made by F. J. Kennedy in March, 1915, with very moderate heats.

Coal carbonized per retort per 24 hours	4 tons
Gas made per ton of coal	9870 c.ft.
Average (gross) calorific power	560 B.Th.U.
Coke sold per ton of coal	9·64 cwt.
Tar sold per ton of coal	13·57 gallons
Sulphate of ammonia sold per ton of coal	30·65 lbs.

RESULTS OBTAINED IN EIGHT GLOVER-WEST VERTICAL RETORTS

With normal steaming but greater heats and slower travel of coal through retorts (April, 1915).

Coal carbonized per retort per 24 hours	3½ tons
Gas made per ton of coal	11,450 c.ft.
Average (gross) calorific power	560 to 580 B.Th.U.
Coke sold per ton of coal	9·25 cwt.
Tar sold per ton of coal	14·5 gallons
Sulphate of ammonia sold per ton of coal	30·5 lbs.

RESULTS OBTAINED IN EIGHT GLOVER-WEST VERTICAL RETORTS

With steam pressure 14 to 15 lbs. on $\frac{1}{10}$-in. nozzles (May to October, 1915).

Gas made per ton of coal	12,560 c.ft.
Average (gross) calorific power	540 to 560 B.Th.U.
Coke sold per ton of coal	8·75 cwt.
Tar sold per ton of coal	16·3 gallons
Sulphate of ammonia sold per ton of coal	32·57 lbs.

TABLE IX.—*Uddingston Gas-Works.*

RESULTS OBTAINED IN EIGHT GLOVER-WEST VERTICAL RETORTS

With steam pressure 25 to 30 lbs. using $\frac{1}{10}$-in. nozzles. October, 1915, to April, 1916.

Gas made per ton of coal	13,554 c.ft.
Average (gross) calorific power	500 to 520 B.Th.U.
Coke sold per ton of coal	8·27 cwt.
Tar sold per ton of coal	17·44 gallons
Sulphate of ammonia sold per ton of coal	36·82 lbs.

RESULTS OBTAINED IN EIGHT GLOVER-WEST VERTICAL RETORTS.

Nozzles widened out of ¼ in. diameter (as small nozzles were constantly getting choked-up). Steam pressure reduced to 10 to 12 lbs. May, 1916, to April, 1917—twelve months.

Gas made per ton of coal	14,450 c.ft.
Gas sold per ton of coal	14,025 c.ft.
Average (gross) calorific power	480 to 500 B.Th.U.
Coke sold per ton of coal	8·64 cwt.
Tar sold per ton of coal	19·17 gallons.
Sulphate of ammonia sold per ton of coal	37·72 lbs.

RESULTS OBTAINED IN EIGHT GLOVER-WEST VERTICAL RETORTS.

Steam pressure 25 lbs. on ¼ in. nozzles. Retorts heated by gas—May to September, 1917.

Gas purified per ton	13,106 c.ft.
Gas unpurified used to heat retorts per ton (say)	4,394 c.ft.
Total gas made per ton	17,500 c.ft.
Average (gross) calorific power	430 to 450 B.Th.U.
Coke sold per ton of coal	10 65 cwt.
Tar and light oil sold per ton of coal	22·07 gallons.
Sulphate of ammonia sold per ton of coal	47·81 lbs.

NOTE.—From May 21 until Sept. 30 no coke was used in heating the setting, gas only being used.

NOTE.—Although the (gross) calorific power of the gas made during May to September, 1917, was only 430 to 450 B.Th.U., it has given very high flame temperature and better results, in incandescent mantles, cookers, and gas-fires, than the gas of over 500 B.Th.U. This is also proved by the amount of gas required per ton of coal for the gas-engines of the extractors, also for the gas-engines of the electric-power plant for coal and coke elevating, as these are using even less than two years ago.

NOTE.—When obtaining the above results the vacuum on the collecting mains was *nil—i.e.*, level gauge.

TABLE X.—*Uddingston Gas-Works.*

RESULTS OBTAINED IN EIGHT GLOVER-WEST VERTICAL RETORTS during month ending Oct. 31, 1917.

Average number of retorts in use, seven (scurfing).

Average coal carbonized per retort per 24 hours	3 tons	
Total coal carbonized per month	653 ,,	
Total gas made	12,710,000 c.ft.	
Gas made per ton of coal	19,450 c.ft.	
Gas used in heating the retorts	2,300 ,,	
Gas available for sale	17,150 ,,	per ton of coal
Coke sold per ton of coal	10·12 cwt.	
(Settings heated partly by gas, partly by producer gas from coke)		
Tar sold and crude benzol sold per ton of coal	23·25 gallons	
Sulphate of ammonia sold per ton of coal	52·34 lbs.	
Average temperate in combustion chambers by Lunette pyrometer, 1200° to 1250° C.		

Results from Nov. 2 till Nov. 6, 1917 (eight and seven retorts).

Coal carbonized per retort per 24 hours	2 tons 19 cwt.
Total coal carbonized	89 tons
Total gas made	1,837,000 c.ft.
Gas made per ton of coal	20,640 c.ft.
(Settings heated wholly by producer gas)	
Average temperature in combustion chambers, 1300° to 1350° C.	
Steam pressure, 16 to 18 lbs., using ¼ in. nozzles	
Average calorific power, 450 to 460 B.Th.U. Specific gravity, 420 to 425	

Test from 11 a.m. on Nov. 6 till 11 a.m. on Nov. 7 (seven retorts).

Coal carbonized per retort per 24 hours	2 tons 14 cwt.
Total coal carbonized	19 tons
Total gas made	442,000 c.ft.
Gas made per ton of coal	23,263 c.ft.
(Settings heated wholly by producer gas)	
Average temperature in combustion chambers, 1300° to 1350° C.	
Steam pressure, 25 to 26 lbs., using ¼ in. nozzles	
Average calorific power, 460 to 470 B.Th.U. Specific gravity, 420 to 430	

Retorts worked very smoothly, although the speed of extraction was reduced. Great advantage was found by giving an unlimited supply of primary air to the producer and throttling the flow of the producer gas in the producer gas duct going to the combustion chambers.

Make 18,000 c.ft. per ton — CO — 15·5 p.ct. and CO_2 — 4·5 p.ct.
,, 20,640 ,, ,, — CO — 16 ,, ,, CO_2 — 5·0 ,,
,, 23,263 ,, ,, — CO — 17 ,, ,, CO_2 — 6·5 ,,

(Percentage of CO_2 was higher, owing to the heats in the lower combustion chambers having gone back, probably owing to excess of steam)

Scotch coal more easily carbonizes than English coal, and gives a much lighter coke (not so dense). Steam passes very easily through the charge in the retort.

TABLE XI.—*Uddingston Gas-Works.*

RESULTS OBTAINED IN EIGHT GLOVER-WEST VERTICAL RETORTS.

Maximum Capacity of Setting of Eight Retorts.

In 1914-15	280 to 300 thousand cubic feet per 24 hours.
In 1916	430 to 450 ,, ,, ,,
In 1917	500 to 520 ,, ,, ,,

Advantages of Steaming (with Lanarkshire Coal).

(1) Greater capacity of plant and reduction in cost of labour.
(2) Increase of 40 to 50 p.ct. in quantity of gas made per ton of coal.
(3) Lower air/gas ratio of gas, with the resulting increase of flame temperature—more uniform composition of gas—percentage of non-bustible gases (CO_2 and N_2) being very low.
(4) Increase of 60 to 70 p.ct. in tar products.
(5) Increase of 50 to 60 p.ct. in ammonia products.

N.B.—The greater quantity of ammonia in the crude gas gives greater efficiency in the scrubbers and washers, and therefore much less purifying plant is required.

On the 5th inst., Mr. Hislop wrote me as follows:

I am favoured with yours of the 2nd inst., asking particulars regarding our reduction in the price of gas.

Up to April 30, 1917, it was 2s. 6d. per 1000 c.ft.; and on May 1 it was reduced to 2s.

Owing to the increased yield of gas and bye-products from the new method of working, we were able to reduce the price as from May 1 last to 2s. per 1000 c.ft.; and we expect (unless unforeseen circumstances arise) to be able to reduce to 1s. 8d. in May, 1918.

The full statutory dividends (as authorized by our Provisional Order, 1902) have been paid during the whole of this period.

Mr. Tallentire, of Lurgan, reports as follows:

I started about the beginning of last winter with a steam pressure of 40 lbs. The yield of gas per ton at the end of our year, with about four months' extra steaming, worked out at 15,501 c.ft., against 14,766 c.ft. for previous year. From May 29 to July 25, 1917, I carbonized 311 tons, with a yield of 16,046 c.ft. per ton. I have not opened the orifice of the steam-jet nozzle; it remains as before. The heat in the second and third combustion chambers has been increased, and the extractor gear has been working a little slower all along. I have had ¼-10th to ½-10th pull on the collecting main, which means about level gauge on the retorts.

The quality of the gas has been, on an average, 500 B.Th.U. On examination, I cannot find that the retort has suffered through steaming. The bottom fire-clay section is still flush with, and in some cases overlapping, the cast-iron section. The surface keeps comparatively smooth—in fact, taking the retorts as a whole, their condition is good, when their length of life and the work done are taken into consideration; and I fully expect they will last another year at the least.

The following are the number of days the verticals have been in action, including days off for scurfing:

No. 1 retort	1857 days	No. 5 retort	1650 days
,, 2 ,,	1820 ,,	,, 6 ,,	1534 ,,
,, 3 ,,	1445 ,,	,, 7 ,,	889 ,,
,, 4 ,,	1246 ,,	,, 8 ,,	738 ,,

It must be explained that the setting is most suitable for very small works; being arranged so that any number of retorts can be put into operation, from one to eight, at any time they are required. Hence the difference in this setting as to the number of days the retorts have been actually at work.

It is instructive to note that there does not appear to be the slightest damage caused to the retorts at either Uddingston or Lurgan by steaming; some of the retorts having been in operation over two and a half years.

On Nov. 5, Mr. Tallentine wrote me:

You may be interested to have the results of the last two cargoes of coals, as mentioned in my letter of Oct. 22: Coals carbonized from July 25 to Oct. 31. One of 306½ tons = make of gas 17,396 c.ft. per ton. The other, 391½ tons = 17,540 c.ft. per ton. In both cases the calorific value was a good 550 B.Th.U., with average steaming at 40 lbs. pressure, and nipples as before.

Mr. J. E. Blundell, of Macclesfield, who recently read a paper before the Manchester District Institution of Gas Engineers, dealt with the special subject of steaming in continously operated vertical retorts; and his remarks fully bear out the experiences of Messrs. Hislop and Tallentire. It will be observed that Mr. Hislop has very successfully utilized the gas for heating his retorts, in order that there may be more coke for sale, which at certain periods of the year realizes such a good price.

In all results of carbonization carried out on scientific lines the aim has been to get as much gas out of the coal as possible, without diluting it with inert gases; and this is a matter that I desire more especially to bring before you. I know that the large majority of those working under the calorific power standard are doing their duty and endeavouring to fulfil their legal and moral obligations. But if any undertakings at the present time are not doing their duty in this respect, and are loading their gas with an inordinate quantity of inert matter, this would be on a par with the colliery owners who are loading their coal with inert matter which is of no value for either lighting, heating, or power purposes; and the whole of the gas industry would be blamed for the wrongdoing of a small minority.

Some time ago the railway companies appealed to the Board of Trade to put restrictions upon the quantity of inert gases to be supplied to them by gas undertakings. But at that time, I think, the Board of Trade very properly did not grant their request. The Board did, however, recognize the importance of not distributing to the consumer a large percentage of useless gas, and referred to the scientifically qualified Board of Fuel Research, presided over by Sir George Beilby, F.R.S., the question of investigating what is the proper constitution of gas for general town supply. We have had considerably more experience since that time; and I am fully satisfied that we have quite sufficient data to work upon, and that it is very advisable to restrict the percentage of inert gases supplied to the public.

I have, during the whole of my professional career, been most careful in this matter, and am convinced that, with care in the manufacture, a very small percentage of inert gases need be supplied in any gas delivered to the public. On looking through the many experiments that Dr. Colman has made for me, I find that the average of many tests is only 4·98 p.ct., and the highest was 8·4 p.ct.; also that in several tests made at Manchester by the late Mr. J. G. Newbigging the average was 5·28 p.ct. and the highest 7·86 p.ct. Again, if you take the analyses of the gas in Mr. Blundell's paper, made by independent experts, they only show 7·87 p.ct.; and if you take the results I have laid before you, it will be seen they are all within reasonable limits. It is said that Nature abhors a vacuum; and if a gas-retort could speak, no doubt it would be of that opinion. My practice has been, where dip-pipes are in use, to work as near a level gauge as possible, and with vertical retorts (where we have no dip-pipes) 1-10th inch pressure inside the top of the retort. In this way

Carbonization of Orrell Nuts Coal for the last Eight Years, showing the Make of Gas, Tar, and Ammoniacal Liquor, at Different Periods produced in the Ordinary Way, and with the Addition of Steaming for Making Blue Water Gas.

	In the Ordinary Way.			Year 1917. Steaming to make Blue Water Gas through ¼ in. Nozzle at the following Pressures of Steam.		
Year.	1909.	1911.	1917.	25 lbs.	40 lbs.	45 lbs.
Make of gas per ton	11,779	12,390	14,078	15,489	16,606	17,461 c.ft.
Make of tar per ton	16·0	18·4	16·8	17·7	20·0	17·8 gallons.
Ammoniacal liquor per ton, 10 oz.	40·76	42·6	33·3	32·6	43·9	Not reliable.

retorts may be kept quite tight, and there is no fear of diluting gas unduly with inert matter.

By the application of the methods of carbonizing coal that I have laid before you, it would bring about a general increase in the make of gas per ton of coal carbonized of from 20 to 25 p.ct, by those who have authority to use the calorific power standard. This would mean a corresponding reduction of coal necessary for making this extra volume of gas, and a saving of plant and labour, which means a considerably reduced cost for manufacturing such gas. A considerably reduced cost per 1000 c.ft. to the public would be possible; and this is a matter of considerable importance in the economic considerations of the future of our great industry.

The above table shows that the quantity of tar and liquor are about the same at medium and high temperatures.

There is no doubt whatever that the giving up of the illuminating power standard has turned out to be a great advance. I am satisfied that gas of a calorific value from 450 to 500 B.Th.U. is the most suitable and economical gas that can be made for all purposes—that is, if it only contains a minimum amount of inert gases. The general question of the calorific standard at the present time is in a bewildering and chaotic position; and we scarcely know where we are in connection with this very important matter. There are only about 120 companies and corporations, out of about 800 gas undertakings, at the present time that have power under this valuable standard. This is a very anomalous position; and quite a number of gas undertakings that are at present bound to the candle power standards would like to adopt the calorific standard, but, for special reasons, are reluctant to make individual application. Surely the time has now arrived when a universal standard on the question should be enforced by law. The present time would appear to be peculiarly suitable for the general adoption of a calorific standard. It is in this direction that there is the greatest scope for the conservation of fuel from the point of view that the best all-round results can be produced. If this standard is generally adopted, it would enable gas engineers to increase the make of gas per ton of coal carbonized. It would also enable all manufacturers to test and standardize all gas appliances for cooking and heating before they are sent out of their works.

Those using horizontal and inclined retorts, and possessing water-gas plant, could with advantage use the latter; and those using verticals that are at present under the candle power standard would be relieved, and could go on steaming and making blue water gas and increase the output of gas, tar, and ammoniacal liquor per ton of coal carbonized.

Another matter I wish to bring before you is the inordinate quantity of shale delivered to gas-works over and above pre-war time. This has caused a general reduction in the quantity of gas and tar that was formerly made throughout the United Kingdom. Taking the examples of the experiments with the Orrell nuts that I have laid before you, Mr. Bond has worked out a statement showing what the results of these experiments would have been if the coals had been delivered with the same percentage of ash as formerly. It will be seen by Table XI. that we lose 1206 c.ft. of gas, 1·40 gallons of tar, and 2·8 gallons of 10-oz. ammoniacal liquor per ton of coal carbonized,

I am very strongly of opinion that the authorities that have guaranteed the colliery owners an extra price for their coal should protect the gas industry and see that they are indemnified for the loss in quality. The great aim of all gas engineers should be both to make and sell gas as cheaply as possible, so that the public would be influenced to a greater extent to use it more extensively for all purposes. The Government at the present time are helping you in the matter of popularizing your gas; and by these means I am looking forward to the time when it will be so cheapened that in the near future fuel will be gasified to such an extent that the smoke nuisance in all towns will be done away with. I give you an example of what is being done in my own house with various modern gas appliances, and which enables me to dispense with coal, coke, petrol, and a considerable amount of labour.

Gas Apparatus Installed.

Gas-fires	7
Wright's circulating boiler for heating boiler and hot-water pipes	1
Richmond's circulating boiler for heating water in four large radiators for hall and rooms	1
Richmond's circulating boiler for heating hot-water pipes in vinery, palm, fernery, and motor houses	1
Richmond's circulating boiler for heating greenhouse, tomato house, and three large propagation frames	1
Cooking range	1
Grillers and boilers	5
Gas-engine for compressing 600 c.ft. of gas for motor	1
Total	18

NOTE.—For experimental purposes, I have separate meters fixed for lighting, cooking, heating, and motoring.

In connection with the domestic coal supply of Southport for the coming season, Mr. Bond worked out what results might be obtained from the products alone if all this coal were gasified; and he gives me permission to use the following table. Mr. Bond estimates that in Southport 100,000 tons of coal are used per annum in domestic hearths. If one takes the efficiency of coal in heat units as high as 30 p.ct. one has a total loss of heat units equiva-

TABLE XI.—*Test of Orrell Nuts.*

Dr. Colman's Test—Aug. 8-10, 1911.	Mr. J. Bond's Test—Aug. 6-8 and Sept. 12-15, 1917.	Corrected to 3·72 p.ct. Ash Content.
	Temperature of combustion chambers, 1393° C., 2539° Fahr.	
TEST OF COAL—		
Moisture 3·90 p.ct.	3·34 p.ct.	
Volatile matter 36·00 p.ct.	31·01 ,,	77·7 tons less 6·13 tons of ash.
Ash 3·72 p.ct.	11·61 ,,	
Coal carbonized 51 05 tons	77·7 tons	71·57 tons
,, per 24 hours in 8 retorts 20·425 tons	15·54 tons in 4 retorts	15·54 ,,
,, ,, ,, in 1 retort 2·55 tons	3·88 ,, in 1 retort	3·88 ,,
Yield of gas, total 632,900 c.ft.	1,094,323 c.ft.	1,094,323 c.ft.
,, ,, per ton of coal 12,390 ,,	14,084 ,,	15,290 ,,
,, ,, per 24 hours in 8 retorts 253,120 ,,	218,864 ,, in 4 retorts	218,864 ,,
,, ,, ,, ,, in 1 retort 31,640 ,,	54,716 ,, in 1 retort	54,716 ,,
QUALITY OF GAS—		
Illuminating power—		
No. 2 Met. burner 15·52 candles	11·16 candles	11·16 candles
Sperm value. lbs. per ton of coal 659 lbs.	539 lbs.	585 lbs.
Calorific value, gross 572 B.Th.U.	522 B.Th.U.	522 B.Th.U.
,, ,, net 513 ,,	475 ,,	475 ,,
Total B.Th.U. in gas per ton of coal 7,087,080	7,351,848	7,981,380
Yield of tar per ton of coal 18·4 gallons	16·80 gallons	18·2 gallons
,, ammonia per ton, 10 oz. liquor 42 6 ,,	33·3 ,,	36·1 ,,
Ammonium sulphate per ton 35·9 lbs.	28·0 lbs.	30·4 lbs.
TEST OF TAR—		
Specific gravity 1·07 at 60° F.	1·089 at 15° C.	1·089 at 15° C.
0° to 170° C. 1·60 p.ct.	0° to 170° C. 2·0 p.ct.	2·0 p.ct.
170° to 270° C. 25·90 ,,	170° to 230° C. 15·5 ,,	15·5 ,,
270° to 350° C. 21·50 ,,	230° to 360° C. 37·3 ,,	37·3 ,,
Pitch 50·50 ,,	Pitch 45·2 ,,	45·2 ,,

lent to 50,000 tons of coal. If this coal was carbonized as in a gas-works, he estimates the result would be as follows:—

	Approximate Figures.
Coal used in the domestic hearth per annum . . .	100,000 tons
Tar that could be obtained from this coal, taken at 11 gallons per ton	5,500 tons
Ammoniacal liquor that could be obtained from this coal would be equivalent to ammonium sulphate .	1,000 tons
High explosives products	600 tons
1,100,000 c.ft., of gas for domestic use	1,100,000 tons

The Ministry of Munitions are still requiring more tar for war purposes; and I submit the following suggestions to meet this demand:

1.—A General Act should be passed for the universal application of the calorific power standard.
2.—The adoption of stripped gas for heating retorts in cases where coke is in great demand.
3.—To insist upon colliery owners picking out the shale before delivery, as in pre-war times.
4.—Gas undertakings to see that gas of only good quality be supplied to the public; thus encouraging the demand for gas.

I think that I have made out a sufficient case that is worth the consideration of Lord Moulton, the President of the Institution of Gas Engineers, the Ministry of Munitions, and the National Gas Council for their early consideration; and I submit that prompt action is of very considerable importance. I believe that there is quite sufficient experience and data to work upon to arrive at a satisfactory conclusion on all these matters, and especially as regards the calorific standard.

In conclusion, I must say that I am gratified to see a notification in the Technical Press that the Fuel Research Committee have formulated a scheme for carrying out some practical experiments on the site of the South Metropolitan Gas-Works. This is a step undoubtedly in the right direction, where scientific men can first make experiments in the laboratory and afterwards prove in practice if they are of any commercial utility; and if this work is thoroughly carried out, I am sure that it will be a good thing for the country generally.

My thanks are due to Mr. A. E. Barton, the Chairman of the Chemical Company, for allowing me to make use of some of the many experiments carried out for them. My thanks are also due to my many friends of the gas profession, for giving me information of their practical experience, all of which I have been very pleased to lay before you. Having regard to the fact that at the present time the Government require large quantities of benzol and toluol, I have undertaken a considerable amount of research with the object of securing, by the vertical retort practice, a greater percentage of these hydrocarbons. In some respects I have been able to secure increases in this direction; but owing to the limited amount of time at my disposal, I have been unable to obtain sufficient data on this important subject to place before the Association. We are still experimenting; and I look forward to bringing this matter to the notice of members and the press in the near future.

DISCUSSION.

FUEL ECONOMY.

The PRESIDENT (Mr. W. N. Westlake, of Exeter), having expressed his obligations to Mr. West, said he had the privilege last March of addressing the members from the chair, and a portion of his remarks referred to the subject of fuel economy. He was not then aware in the slightest degree what would be the business on this occasion, but it seemed to him that the business that had resulted through the circumstances of subsequent time was a very great compliment to the remarks that he himself had the honour of placing before the members. The question of fuel economy, it appeared to him in the early months of this year, was really a very important one, and the subject upon which it would be well for the gas industry to concentrate in the immediate future. In having Mr. West there that day, they were assisting to solve a question which was of great national importance, and of vital importance to the gas industry.

UNPURIFIED GAS FOR RETORT HEATING.

The paper bristled with points; but he was not going to take advantage of his position to deal with them, because he knew there were many who wished to follow. He would take only one point upon which probably the members would like more information. It concerned the use of unpurified gas for heating the retorts. In Table X, giving the results from the Uddingston Gas-Works, they were told that 4394 c.ft. of unpurified gas per ton were used for heating the retorts; and, from the figures given, it seemed that, in doing this, about 2 cwt. of coke was saved. The sale of coke had apparently risen from 8·64 cwt. per ton of coal to 10·65 cwt. How should they take these figures? If they took 4394 c.ft. of unpurified gas at 1s. per 1000 c.ft., it would amount to a little over 4s., and then there was the saving of 2 cwt. of coke at 1s. per cwt., which made a difference of 2s.; so it appeared to him that the use of the unpurified gas for heating the retorts was not quite justified. The quantity of gas used had evidently been estimated as nearly as possible. It would be most interesting if Mr. West would give them more information on this point. As to the discussion, he should first call upon the specially invited speakers; and, in doing this, he had to say that Mr. Lacey, who was one of them, could not be with them. This was the only day that his son could obtain leave before proceeding overseas. What spare time Mr. Lacey had, they must agree, he should spend with his son before he left the country.

EVENTS LEADING UP TO THE PRESENT POSITION.

Mr. W. DOIG GIBB (London) said he was in a most unfortunate position, as he had only managed to get a copy of the paper about midday—not through the mistake of anybody, but through his wanderings about the country. His remarks would therefore necessarily be very general, and must be taken as a preface to the better things to follow, rather than as a criticism of the paper. Mr. West's communication would have serious attention first because it was made by a gentleman with a considerable knowledge of the subject with which he dealt, and, secondly, because his special subject was of vital importance at the present time. It was therefore best to approach its consideration with a full knowledge of all the governing factors which had gone before, and which were yet important. A consideration of these might well be prefaced by the quotation of a recent remark in one of the technical papers: "In this extraordinarily phased war, transitions of situation come rapidly, and decisions have to be varied accordingly, and that expeditiously." This was concisely and accurately stated. The first special requirements of the Government were benzol and toluol. These had been met voluntarily by many gas undertakings in such a loyal way as had prevented up till now any serious situation being caused by the lassitude of some, indifference of others, and absence of conscience by a few who, after receiving the benefits of the Standard of Calorific Power Act, had almost entirely failed to "play the game" to which they, in honour, were committed. It may be useful to put on record that the Government not only desired the output of benzol and toluol to be maintained, but to be increased if this could be done without detriment to other required materials and products. Then came the scarcity of coal, and the consequent appointment of a Coal Controller. The immediate effect of this was to sever many old-standing friendly relations between collieries and their customers, by its being ordered that "no coal shall be sold at collieries for consumption in the United Kingdom except at the maximum price under the Price of Coal (Limitation) Act." He was not inclined to disagree with the wisdom of this Order in the special circumstances under which it was made. The coal redistribution scheme came along immediately after. The primary object of this was to cut-down railway mileage; and he had no doubt this had been accomplished, even though there were numerous special cases which could be proved to the contrary. It must, however, be remembered that the question should be considered nationally, and not from the point of view of any one particular gas undertaking. He had sympathy with the representations made that, no matter what coal was supplied, it should be clean, as railway mileage was entirely wasted in conveying dirt and other unnecessary impurities to be dumped at gas-works, instead of at the collieries. Surely a greater supply of labour at the pit heads would be a national economy—transit saved, labour costs in gas-works saved, better coke fuel for the public, and a greater possible output of gas from plant, which in many cases was not now equal to the maximum demands of consumers. An appeal to use more gas followed, in order to save the transit of coal to be used in uneconomical ways. This, in itself, was a sound economical appeal, but was necessarily ineffective unless backed by the co-operation of the priority, labour, and Coal Controller's departments. Unfortunately, this was the time when it became necessary to increase the cost of coal at the pit head by 2s. 6d. per ton. Gas undertakings could only make ends meet (or, by recent evidence ably prepared by the North of England Gas Managers' Association, endeavour to make ends meet) by raising the price of gas. These nearly coincident events were not properly appreciated by many gas consumers, who only knew of an appeal to use more gas, followed almost at once by a very general increase in its price. Few consumers followed the complete cycle of events in such a way as enabled them to logically reason out the inevitable consequences of a rise in the price of coal. Then followed an appeal to use water gas instead of coal gas to the greatest practical extent. Scarcely had this appeal been issued, when, through changed circumstances, it became desirable to encourage the use of coal gas for the sake of its bye-products. Then came the call for more tar. Low-temperature carbonization in those works which had spare plant seemed the only way to quickly make an appreciable difference in the output. It was recognized by the Department, and was the view expressed by their experts, that this could only be done at a greatly increased cost; and it became a question (in consultation with the National Gas Council) of preparing estimates. The result was now known. In connection therewith, let him again quote "transitions of situation come rapidly." The present situation was that more tar, especially for its yield of fuel oil, was required; and it behoved everyone to do his best to supply this, so as to prevent the position becoming a critical one. The relation between creosote oil for fuel and the supply of gas oil to carburetted water-gas plant would be readily understood. They therefore welcomed such a paper as they had heard that day from Mr. West. Very many proposals, generally covered by provisional protection or by full patents, had been made. All had been, or were being, investigated; and he was justified in saying that the Ministry of Munitions were fully alive to the importance which should be attached to any process likely to produce fuel oil at a reasonable over-all cost. It must, however, be a commercial proposition, having regard to all the circumstances; and the views of the Ministry and those of inventors (and he might add dreamers) were often diametrically opposed to one another. He would leave to others a more direct discussion of Mr. West's experiments. Generally speaking, he was still of opinion that lower temperature carbonization would result in an increase of the residuals which the Government required—*but at a price*. Granted the facilities in spare plant, the supply of coal and labour, &c., it then became a question of a balance-sheet between the varying systems.

THE POINT OF THE PAPER.

The great interest of Mr. West's experiments appeared to him to be contained in the introduction of steam into the retorts. It was, of course, well known that this method had been used to increase the make per ton (so-called) by using part of the coke contained in the retort for the production of water gas. There was, however, the other question of the capacity of the steam, or resultant water gas, to carry away from the hot walls of the retort the oil-yielding heavy vapours which might be cracked-up under non-steam conditions. But it was difficult to understand why, when steam was "afterwards introduced," the tar

product per ton should be so materially altered. In these remarks, he did not overlook the admirable paper recently read by Mr. Blundell, of Macclesfield, to the Manchester District Institution of Gas Engineers. It could be commended for careful consideration by every gas engineer. Many experiments and investigations were being made at the present time by the Ministry of Munitions; and they were as anxious as any person could be to get such information as would enable them to recommend the best processes of carbonization for the country, and for the operators as well. But Mr. West's published letter at the end of August of this year was based on what, through no fault of his own, was an imperfect knowledge of the then requirements and aims of the Ministry. At the same time, it would be recognized, and gladly so, that the work of Mr. West was in the right direction towards what they must all aim for now—the economic national working of all processes conducted in this country. The questions in regard to carbonization of coal and similar substances were not confined to gas-works practice only. They ranged from the utilization of pit refuse distilled by the heat from a portion or the whole of the evolved gas, and from each ton of which from 30 to 58 gallons of tars and oils had been extracted, to such processes as the one which they were now discussing, where the gas yield had to be considered as well as the bye-products. It was interesting to note that Mr. West in his paper revealed the coal used in the No. 1 experiment mentioned in the communication of Aug. 22. He did not agree with him that the quality of Kent coal was unknown, and if ever any coal should first have been tried on a small horizontal test plant (as he subsequently did with other coals), it was surely Kent coal. There was an error in Table V. The 6·33 candles should be 14·8 candles. Was it, he asked, right in Table V. (medium temperature) and in the summary of the advantages, &c., to claim double and treble the labour per ton which was required for lower temperature carbonization? Surely the labour would be much the same per ton of coal carbonized, if labour arrangements were properly adjusted. It was to be regretted that Mr. Hislop's first table was not the result of the carbonization of coal in vertical retorts. He had no doubt that there was some reason for this, as Mr. Hislop was a careful and competent investigator; but "vertical" results would have been of greater value for comparison. He was sorry that his remarks, through no fault of his own, had been so general; but he was sincere in his thanks to Mr. West for having made public the results of his many complete and valuable experiments.

SOME INQUIRIES.

Mr. H. O. CARR (Wandsworth) said Mr. West had contributed a very valuable paper at a time when it is most desirable. It contained information in such a concise form as to be easily referred to, and he deserved their hearty congratulations. A celebrated artist on one occasion was asked how he mixed his colours to produce such exquisite effects. His reply was: "With brains, sir." This was precisely the material which had been mixed with the matter presented in Mr. West's paper. It would be an act of impertinence on his (Mr. Carr's) part to criticize the facts given by such an able and long experienced practical carbonizer as Mr. West. This he did not intend to do, but could only ask for further information on certain points. One was as to the percentage of paraffins and unsaturated hydrocarbons found in the tar and crude benzol produced by the vertical retorts as compared to that produced by horizontal retorts, and as to which might be considered the better method to adopt in order to obtain the best quality of bye-products needed for war material, as, when more than a certain small percentage of paraffins and unsaturated hydrocarbons were present in crude benzol and light oils, a quantity of valuable acid was required, in some cases, to render the benzol and tar oils of use to the State for war purposes. It would also be useful to know if any of the varieties of coal that had been carbonized in horizontal retorts were unable to be used in vertical retorts, and if the coal for verticals had to be selected, screened, and of such good quality that, supposing the benzol and tar oils contained large quantities of paraffins, it would not be better to carbonize such coals, during war time, in horizontal retorts where the benzol and tar oils so produced were found to be so free of paraffins and unsaturated hydrocarbons as to be suitable for war material. One satisfactory feature in regard to verticals was that they appeared to be able to recover considerably more ammonia per ton of coal—a product which was of vital importance at the present moment. Mr. West's paper should "lay low" for all time the question of low-temperature carbonization.

BAD COALS AND GRAPHIC STATICS.

Too much stress could not be laid by the author, backed up by Mr. John Bond, on the increasing percentage of inert material now being included in gas coal and the losses in every way which arose from it. The average tests of several varieties of Durham coal received during three months this summer compared with a corresponding period in 1914 were as follows:

	Volatile.
1914	28·26 p.ct.
1917	24·33 ,,

This was a loss of 3·93 p.ct. on the volatile; and it required no less than 16 p.ct. more volatile matter to be added to that of 1917 to bring it up to the volatile percentage of 1914. This figure was about equal to Mr. Bond's experience between 1911 and 1917. He stated the loss of gas per ton as 1206 c.ft. He (Mr. Carr) considered in their case the loss to be nearer 2000 c.ft. per ton. If these figures applied to the whole 18 to 19 million tons of coal carbonized by the gas undertakings annually, let him describe in graphic statics what it meant. It meant that nearly 3 million tons of inert material per annum was being delivered in the coal as compared with 1914. If they could imagine a fleet of 1500 ships of 2000 tons each filled with inert material, it represented what they were receiving per annum over and above that in the coal supplied in 1914. Similarly it represented a line of 300,000 ten-ton trucks, and would occupy a line of trucks three abreast from London to Edinburgh, and 7500 railway engines to draw them. What must it be for the whole of the coal produced? Beyond the losses due to this cause, pointed out by the author in regard to gas and residual products, many evils were thrust upon gas men—such as loss of storage space; extra cost of handling and conveying; loss in capacity of works in both coal gas and blue water-gas plants; bad coke and breeze for coke consumers; poor heats for retorts in consequence of poor fuel; a larger amount of clinker causing extra labour to be employed, both in dealing with the clinker in fires and its removal, as well as the additional cost of getting it removed from the works. He had been told in certain quarters that it was not possible to materially alter the existing state of affairs in regard to cleansing the coal. From inquiries he had made up North, it appears that the "boys" who cleaned the coal, but who really were full-grown "men," were scarce now, and that the men were not likely to tolerate women being employed to help. He could not think in these days when women were so largely employed in most industries that the tremendous importance of clean coal could have been properly explained to the men by those who should do so, and that if the matter was again put to them in a more attractive form—by pointing out how a few women employed to help them at each pit could do so very much more to win the war by providing a largely increased output of explosives, the saving in transit, and the enormous amount of labour saved which could be used more profitably—it would be found that the mineworkers were a reasonable body of men, and would consent to a trial of women labour to assist them to clean the coals. When it was considered how exceedingly important it was at this period of the war that gas-works should turn out as much gas and residuals as was possible with the plant at disposal, it was palpably absurd not to supply them with the very finest quality of coal procurable for the purpose, and thus cut down to its lowest limits the percentage of "blue" gas which now had to be used to make up the deficient output of coal gas due to poor coals. "Blue" gas was a very poor substitute for coal gas.

CONTROLLED PRICE OF COAL AND EXPORTED COAL.

Now that the price of coal was controlled, it enabled gas-works to decide what was the most useful amount of gas to make per ton for all purposes, including war. But before coals were subject to control in price, and exported coal was wholly unrestricted, it was necessary to make a ton of coal yield as much gas as possible for economy's sake, as if, for instance, they had stuck to (say) 12,000 c.ft. per ton, instead of 13,000 c.ft. and over, it would have had the effect of using more coal and forced-up home prices. He was one of those who held the view that it would be of the greatest possible benefit to this country if, during normal times, coal was not allowed to be exported for the express purpose of keeping-up home prices, and especially considering, in regard to the gas industry, the greater uses to which gas and gas products were going to be put—the development of the dye industry, drugs, &c., motor spirit, and the latest war development, "motor gas," which, owing to its cheapness, was going to stay longer than most people thought. But it was a new development, which could not by any means substitute the whole of the petrol annually imported into this country, as the gas plant at present in the country could not any way turn out the extra gas required to take the place of all imports of motor spirit, but could only be used to a comparatively small percentage for substitution. It would require something like 3¼ million tons extra of coal to be carbonized annually to replace the 170 million gallons of spirit imported; and as at present only approximately 18 to 19 million tons were being carbonized at gas-works, this would represent an average increase of 18 p.ct. It would be seen that even the demands shortly to be made in regard to "motor gas" would be considerable, more especially in large towns, as it was there that the greatest amount of petrol had been used. But during the lighter months, where it could be managed, a certain number of retorts could be kept going to supply the demand. Now, coming back to the question of coal exports from this country, he would like to point out how very unwise they had been in the case of Germany. The figures he gave were those from returns issued just prior to the war, and were stated in round sums. About 3½ tons in every 100 tons annually raised went to Germany, or about 9 million tons, which was equal to 1 ton in every 8 tons exported from this country. This country had provided Germany with over 6½ p.ct. of her total home consumption, although Germany was a fairly large exporter of coal herself. The 9 million tons exported to Germany was of the finest coal produced—5,160,000 tons of steam coal (a large percentage of which was anthracite; 2,800,000 tons of gas coal, or more than was consumed annually by the largest gas company at home; 340,000 tons of household coal; and 700,000 tons of other sorts of coal. While this country was sending 9 million tons of its finest coal to Germany—Germany herself exported about 11 million tons of her inferior coal to Austria-Hungary; no doubt making a fine profit out of it, considering Austria-Hungary could only raise 50 p.ct. of native coal. It might be asked how did this affect this country and gas undertakings in particular? In the first place these exports were used unfairly to keep up home prices here, with the result that, as he had been told, and he believed quite correctly, it was often possible for gas coal to be landed from boats at Hamburg at 1s. a ton cheaper than in London; and not only so, but as the English imported coal was used generally for Germany's northern industries, its superior quality and low price helped Germany to produce articles of commerce so cheaply as to seriously damage the world's markets for the United Kingdom. It would be far better for the future if such a tax was placed upon exported coal as to greatly cheapen the price of home consumed coal, in order that factories might be set up in this country instead of in foreign countries, and thus be able to supply articles of commerce at a price which would regain this country's lost markets. Needless to say, the more factories were erected in this country the greater the benefit to the gas industry, as not only would the factories require gas, but the employees would become consumers also. A great argument among coal owners was that as coal was exported to all parts of the world, it kept a large number of British ships employed. But to this, he would retort, that if these same ships went to all parts of the world filled with British manufactured goods instead of coal, it would be far better in every respect for the British Empire. If they wanted to make more certain than ever of winning the war, let the gas undertakings producing explosive materials have the finest coal procurable for the purpose, and at the price they were now paying for the present supplies, and let inferior coal be employed to replace the best coal used where it was really not required.

INERT MATERIAL IN COAL.

Mr. G. M. GILL (South Metropolitan Gas Company) remarked that upon the greater part of the matter contained in Mr. West's paper he had nothing to say, except to thank him for presenting it to the Association. There were one or two matters in it, however, which seemed to be of pressing importance just now. One was that mentioned by Mr. Carr—the much increased ash in coal. There was no doubt about it this was really a most serious matter. At one of the works of the South Metropolitan Company, they had got out some figures, which showed the amount of residue in the form of ash and clinker that they had to send away. Per ton of coal, it was actually double the quantity that obtained before the war. Prior to the war, the figure was 0·65 cwt. per ton of coal; and now it was 1·28 cwt., which was practically double, in spite of the fact that they had lately improved their methods of extracting as much as possible of the coke from the residue. This, he thought, was a very serious matter, because the ash in the coal to a large extent took the place of the volatile matter; they lost volatile matter from which to make gas, tar, and ammonia. Then, again, this was brought home very forcibly to his Company, because they had to provide barges for taking away the ash. They found they had to very greatly increase the number, and he agreed with what Mr. West had said in the paper: "I am very strongly of opinion that the authorities that have guaranteed the colliery owners an extra price for their coal should protect the gas industry, and see that they are indemnified for the loss in quality." If the colliery owners did indemnify them, this would probably put the matter right; but so long as the colliery owners could get them to pay for ash in the coal, so long would they go on selling it. This was surely a matter for the Coal Controller to put right.

INCOMBUSTIBLES IN GAS.

Then the question of inert gases, about which Mr. West also spoke, was another matter that was undoubtedly of the gravest importance. If they tested a gas-fire with gas containing (say) 12 p.ct. of inert gases and then with 24 p.ct., although the two gases might be of the same calorific value per cubic foot, a very different result would be obtained. In the South Metropolitan Company, they had been used to working to a limit—a very strict limit—of 10 p.ct. of nitrogen as a maximum; and if they added the carbonic acid and oxygen, the total was about 12 p.ct. He thought that this limit was quite a good thing. It meant they were making a good gas; but to do it they, of course, lost something in their make per ton. And unless the leaks in the retorts and mouthpieces were very carefully looked after, there was no doubt about it, the make per ton dropped a good deal. They found it most important to take very great pains to see that their mouthpieces and lids were tight; and the practice followed was to test every mouthpiece and lid before it was put on the retort to 5 lbs. water pressure per square inch. In this way, the inert gases could be kept down very materially.

THE HISTORY OF THE TESTS.

Dr. F. MOLLWO PERKIN, Ph.D., F.I.C., F.C.S., said he should like to say a few words about the inception of the power scheme outlined in Mr. West's important paper. Shortly after the war broke out, Mr. Barton (who is connected with Scandinavian industries where the processes are carried out with cheap power obtained from water) realized—as many others had—the importance to this country of cheap power for industrial purposes. With characteristic energy, he commenced to work out a scheme at once, and, together with his advisers, drew up a scheme. Naturally, coal was looked upon as the starting source for obtaining the power; but how it was to be developed was another matter. Provided that the bye-products necessary for the various processes could be obtained, then it was immaterial whether the coal should be carbonized at high, intermediate, or low temperatures. Indeed, in the first case, low temperature carbonization was considered; and by low temperature he meant really low temperature—500° to 600° C.—such as was unknown in the gas industry. A study of the processes showed, however, that, even if they were economical for the production of smokeless fuel, and gave a larger yield of tar than was generally obtained by high temperature carbonization, the tar did not contain the right constituents for Mr. Barton's scheme. Attempts were indeed made to crack this low-temperature tar, in order to try and obtain hydrocarbons of the benzenoid series, because tar obtained by low-temperature carbonization consisted in the main of paraffins and olefines. These tests were not successful. Consequently, other processes of carbonizing were considered; and ultimately it was decided to carry out tests at high temperatures. At the beginning of this year, Mr. Barton had an interview with Mr. West; and although Mr. West had, as he put it, semi-retired, he was so interested in the scheme, and recognized its national importance, that, with characteristic enthusiasm, and after seeing Mr. Glover, he suggested that the large vertical retorts at St. Helens could be employed for carrying out the tests. He should like to say here that it had been a source of great gratification and pleasure for him to have worked side by side with the "doyen" of gas engineering; and without his ripe knowledge and clear conceptions, the test would, undoubtedly, have been much prolonged. A large number of coals from different collieries were first tested in the laboratory, in order to ascertain which would probably give the most satisfactory results. If the results were satisfactory, it was intended, if possible, to purchase a colliery, and put up retorts at the pithead, thus saving transport and other charges. Although Kent coal was poor, and did not bear transport well, it was first tested, because it would be a national asset if the Kent coals could be profitably worked. Some 750 tons of Kent coal were sent to St. Helens, and tests were commenced in January. In reply to Mr. Doig Gibb, he might say that the samples of Kent coal first received gave a fair analysis—about 28 p.ct. of volatiles; but the samples taken from the 750-ton lot gave the analysis set out in Mr. West's paper. The setting at St. Helens consisted of four Glover-West retorts; and each retort would carbonize about 4 tons of coal in twenty-four hours at high temperatures. To their surprise, they were only able to carbonize 2·6 tons of Kent coal, and the yield of gas and tar was also very low. Strangely enough, although high in ash, the coke was very good, and burnt very well in the producers for heating the settings. Various temperatures were tried; but, finally, the tests had to be abandoned, because they were unable to give Mr. Glover sufficient gas to maintain the St. Helens supply. It was then decided to first test the coals at Southport on the small experimental horizontal retorts Mr. Bond employed for test purposes. These retorts were self-contained, and were connected with coolers, purifiers, and a gasholder, so that all the products could be collected and examined. Generally speaking, several tons of coal were employed for each test; so that adequate quantities of tar, liquor, &c., could be collected and examined. The behaviour of various coals at temperatures ranging from 900° to 1300° C. was tried. Finally, they selected coal from the Haigh Moor seam of the Kilnhurst Colliery. This coal was put through on a large scale at St. Helens. The coal contained 31 to 32 p.ct. of volatiles and about 7 p.ct. of ash. His impression was that about 1200° C. would yield the best results; but Mr. West thought a higher temperature would be best, and this turned out to be right. Different temperatures were tried until they got up to 1400° C.; and here they obtained the best results. His fear was that the refractory material of the retort segments would not stand such a very high temperature; but he was agreeably surprised that no sign of deterioration was shown even at this high temperature. At this temperature, they were making from 13,800 to 14,000 c.ft. of gas per ton, about 16 gallons of tar, and about 25 to 26 lbs. of sulphate, and a very good coke. It then occurred to him (Dr. Perkin) that the yield of tar might be increased, and also the proportion of benzenoid compounds in the tar, if they were to strip a portion of the gas made, and return it up through the hot coke at the bottom of the retort. After consultation with Mr. West and Mr. Bond, distributing-pipes were fitted into the retorts, and stripped gas in varying proportions was passed up through them. The amount of tar produced per ton of coal carbonized showed an increase; and there was also a slight increase in the gas make. The sulphate remained about the same; but the coke was practically free from volatiles. The throughput of the coal in twenty-four hours was 4·25 tons. A large amount of experimenting was necessary before it was found how much gas should be returned. Ultimately they arrived at a point at which the best results were obtained. By this method with this particular coal, the increased yield of tar per ton of coal carbonized was from 2 to 2½ gallons—that was to say, they were obtaining from 18 to 18½ gallons of tar per ton. Another important point was that there was an actual increase of benzenoid constituents in the tar. It was interesting to notice that, if the gas introduced was increased beyond certain limits, the tar yield began to decrease again. Now whether steaming or the return of stripped gas through the retort should be resorted to would depend upon the requirements. If large volumes of gas and big yields of sulphate were required, then undoubtedly steaming was the right process. The tar yield would be large; but it contained more paraffinoid constituents. Such tar should, however, form a valuable fuel oil. For the purposes of the scheme diagrammatically outlined in Mr. West's paper, where bye-products were of prime importance, the return of gas through the retorts was the better process. In either case, the higher the temperature the better the results. He was inclined to think that one reason why the retort linings were not damaged by steaming was owing to the protective action of the scurf. Therefore it would probably be found advantageous to run the retorts for a few days before injecting steam.

HIGH TEMPERATURES AND FUEL OIL.

Dr. HAROLD G. COLMAN (London), invited by the President, said he had had no intention of speaking upon the paper. The fact of the matter was that there was so much one could discuss in the paper that one did not know where to begin. This was purely a question of the economical carbonization of coal; and he agreed fully with what Dr. Perkin had said, that they were considering here the economical carbonization of coal from the point of view of those to whom the make of gas was the fundamental proposition. The results which Mr. West had brought before them that day were of great interest to him (Dr. Colman), as he had been concerned with many similar tests on the same plant; and he could bear out the statement that, so far as the use of vertical retorts was concerned, the yield of oil was not decreased by the use of high temperatures. If he might take the test Mr. West gave in Table VII. with two days' steaming at 40 lbs. pressure, they had there a very high temperature—1387° C.; and yet, working-out the figures from the tar analysis and the yield of tar per ton, the actual amount of fuel oil obtained per ton of coal was 7¾ gallons, as compared with the ordinary figure of something like 3 gallons of creosote per ton of coal with ordinary high-temperature working in horizontal retorts. He must say that, although in these experiments they were dealing with high temperatures outside the retorts, it should be remembered that really a good many of the changes going on in the retorts were nevertheless low-temperature ones, because, in the case of the continuous retort, though they might have a high temperature outside at the top, the temperature inside was much lower, owing to the fact that cold coal was entering at that point, and the oil products were mostly evolved in the upper portion of the retort. Therefore, in point of fact, although the temperatures outside the retort were so very high, the actual temperature to which these products were subjected before they got away from the retort was not so high as in the case of the horizontal retort. Perhaps he might also bring in Mr. Blundell's recent paper on this subject, because it bore upon the point of the yield of fuel oil per ton of coal carbonized under gas-making conditions. From his experiments it appeared that, by working with additional steam and higher temperatures as compared with his previous working, he got a 40 p.ct. bigger yield of fuel oil per ton of coal than he did when he was working lower temperatures and a smaller quantity of steam. But he also decreased the throughput of coal by the same plant by 10 p.ct.; and therefore this would mean that the plant did not produce 40 p.ct. more. That was to say, as there was 10 p.ct. less coal put through, he would only get 20 p.ct. increase by that plant in the amount of oil produced per day. He got 40 p.ct. increase per ton, but 20 p.ct. from the same plant per day. The same indication ran through Mr. West's results. This he (Dr. Colman) thought was a matter of considerable importance in regard to knowing or anticipating what was the best line they were to take in the future. For in the future, unquestionably, though gas would be their main product, the oil question was going to be of much greater importance both for the country and, he hoped, also financially for gas undertakings, than it had been in the past. Another matter which was referred to in the paper, as well as by Dr. Perkin, was of very great interest—that

was, the return of stripped gas to the retorts, and the effect of this upon the yield of tar or oil products. Dr. Perkin had told them generally the results of the experiments; and they confirmed similar tests that he (Dr. Colman) was making before the war broke out, and which were discontinued on account of the war. Though the tests were not carried out so far as they would have been had the war not intervened, they got practically the same effect indirectly by steaming. At the same time, there was a difference between the effects of the two; and he was rather inclined to think it would be found that a combination of the two—that was to say, a certain amount of steam for producing water gas in the retorts and a certain amount of stripped gas returned—would very likely prove to be more effective than if one method was used alone. He could not, however, speak with confidence until experiments had been tried. He expressed hearty thanks to Mr. West for his paper and the results.

High and Low Temperature Working.

Sir ARTHUR DUCKHAM, K.C.B., remarked that unfortunately he had not had an opportunity of studying the paper; but there was one point he would like to raise, with reference to comparing high and low temperature working. They felt they had to go to low temperatures, not for gas-works specially, but for other purposes—more particularly fuel oil. He thought it was not quite fair to low-temperature carbonization to compare the working under high temperatures of a very fine system with the same system used for low temperature. He knew of no system of low-temperature working at the present time which could be called ideal—nothing comparable with the retorts used for high temperatures. Mr. West suggested that a General Act should be passed for the universal application of the calorific power standard. Present times were very troublesome for all of them; and he thought that gas-works, so far as he had seen, had had about as rough a time as anyone. But still it was a time of great opportunity, when people's ideas were in a flux; and he was certain that if the gas industry made out a case, as a whole, they would receive better attention than they had ever been able to have before, if they put it forward at this juncture. He felt this very strongly. This question had been discussed in several places; and he was certain that now was the time for the gas industry to get together, and decide which was the most efficient gas to produce, and ask for permission to distribute this gas to the consumer. As he had remarked, he thought gas undertakings had had a very bad time; but he was glad to say that the Ministry of Munitions had awakened to the fact that they had not been properly looked after in the past. ["Hear, hear."] He hoped very much that in the immediate future there would be somebody in the Ministry specially delegated to look after the gas industry, so that undertakings might know to whom to go when they were in trouble.

Water-Gas Percentage and Costs.

Mr. THOMAS GLOVER (Norwich) said he would like to draw attention to the percentage of water gas as given in the tables. He did not think that Mr. West had mentioned the percentage, working it out from the 14,084 c.ft.

Mr. WEST: It should be 13,000 c.ft.

Mr. GLOVER said he was taking from one table 14,084 c.ft. at high temperature, without steaming, and the 17,460 c.ft. in the other table produced with steaming. This gave a difference of 3376 c.ft.; and if this was worked out in the 17,460 c.ft. it gave 19 p.ct. of water gas. This, accompanied by the 17 8 gallons of tar at the same time, seemed an extraordinary figure. He had, of course, no reason to doubt it, because these tests, he took it, were beyond dispute.

Mr. WEST: I did not make them.

Mr. GLOVER said he did not expect this 19 p.ct. of water gas was obtained for nothing. The difference in the quantity of coke produced under the two systems seemed to be remarkably small; and it did not take into account the cost of the steam used. Possibly the author would answer this. He (the speaker) did not think they ought to ever believe that they were getting "something for nothing;" but it was possible, of course, to waste a great deal of good matter, and think they were doing very well. The paper, if it proved anything, showed they could get very much bigger makes per ton without losing other products—it showed the virtues of the vertical retort system. Many of them had wished to pass steam through their coke with horizontal retorts, but had not found a successful method of doing it. The vertical retort system, however, lent itself admirably to the purpose; and there was practically no labour attached to it. Water gas must be made very cheaply under these conditions; and he presumed the plant necessary for this huge make per ton of coal gas and water gas occupied a very much less area of ground than would be the case with any of the ordinary methods of carbonizing coal, *plus* a water-gas plant. It also involved less machinery, because in making water gas in the usual way they must have blowers and various other appliances, which did not seem to be required for the simple process of steaming vertical retorts. It did appear to need more heat in the lower sections. This transpired, he thought, from Mr. Blundell's recent paper; and that, of course, one was not surprised at. Apart from this, the conditions for making water gas seemed admirable. Mr. West was a most persistent experimenter, and had been all his life; and this paper did him wonderful credit. The Association, also, were to be congratulated on having had such a paper presented to them.

Something of Considerable Value for Something of Small Value.

Mr. ARTHUR VALON (London) remarked that Mr. Glover had just said they could not expect to get anything for nothing; but, as a matter of fact, if they could not get something for nothing, they could frequently get it for a very small expenditure. He was reminded of this, because the essence of the system of Mr. West's was making water gas in a vertical retort or—he wanted to take the two together—passing stripped gas back through the retort and conducting the carbonization in a gas atmosphere which came from outside the retort. This was not new. It was done, he believed (though he had not his notes with him), as far back as 1862. At any rate, it was a long time ago; and it had been tried at various intervals since—not in vertical retorts, but in others. He had tried it himself in a horizontal retort, and had to abandon it for reasons of practice, because at the time it was not stripped gas but ordinary gas going back. The experiments now detailed showed that with this mixed gas—that from the coal, together with that put into the retort—one got a very much higher calorific value than if one made the two separately and then mixed them. Thus, if they did not absolutely get something for nothing, they did get something of very considerable value for something of very small value. When he saw these results, he was not surprised to find there were very substantial advantages to be obtained by the system which had been explained by Mr. West. It seemed to him that the real value of the paper was the comparison of results of different methods of working; and looking through these results, he found there were one or two points of difficulty in comparison. For instance, take the analysis given in Table II., where comparisons were made as to the value of products obtained from a ton of coal. When he saw this, he was afraid a great many years had fallen away, and he was back again in his pupilage, for he found the gas value was calculated at so much sperm. A comparison of the value of products in which the gas was valued according to the equivalent in pounds of sperm, was quite useless from a modern point of view. Other products were valued on the amount obtained for them; and the gas should be valued according to the price obtained for it. Any particular process or method of carbonization would vary in value according to the position of the works which might contemplate adopting it. For more gas, one system would be better; and for more coke, another system. It was, in fact, quite possible to increase the total value of the products from a ton of coal, and yet to decrease the total profit drawn from the concern in the course of twelve months. Following upon this, there was another point. He noticed in regard to these comparative results that the calorific value varied from about 430 to 600 B.Th.U. How were they to allow for the difference in value of the gas? In any particular case, one could take the price one obtained for it; but when there were a whole series of tests like this, how could they tell the exact difference in value between one method and another, when with one there resulted 430 B.Th.U., and with the other 600 B.Th.U.? They could not take merely calorific value, because they were told in the paper it made a lot of difference whether one got inert gases, and what was the flame temperature of the particular gas. Therefore, one could not say that a gas of 400 B.Th.U. was worth four-fifths as much as a 500 B.Th.U. gas. There were very few experimental results obtainable as to the effect of varying the calorific value. He wondered whether Mr. West had such results. It bore considerably upon the apparatus one consumed the gas in, and the purpose for which it was used. Then as to the inert constituents. Something had been said by Mr. Gill which permitted him (Mr. Valon) to hope he might have some experimental results to give to the industry. It would be interesting to know what was the real effect of varying the inerts, when one kept the calorific value even. If one had a 500 B.Th.U. gas, and kept it at 500 B.Th.U., what difference would 1 p.ct. of inerts make in the value of the gas for use? It seemed to him that, except for those purposes in connection with which flame temperature was of importance, the percentage of inerts, within limits, did not affect the question. He knew that here he was differing from most people who had dealt with this subject. To mention one thing. For heating water, it did not matter what the inerts were, provided one had the actual 500 B.Th.U. On the other hand, for incandescent burners it might matter. But here was a warning. It was quite possible to imagine one could have such a proportion of constituents of a gas that it would pay to dilute it with nitrogen, which was an inert gas, rather than with hydrogen, which was not. A high calorific value gas diluted with nitrogen to bring it to 500 B.Th.U. might give a higher flame temperature than if diluted with hydrogen. These were some of the points from among the many he had noted. He hoped Mr. West would be able to give them particulars of the experimental results upon which he based his opinion that 430 B.Th.U. was the proper gas to supply.

Some Results from Scotland.

Mr. LAWRENCE HISLOP (Uddingston) said he could supplement the results given in the paper by figures which were obtained during October at his works,* when the gas was only partly used for heating the retorts, the other part being producer gas from coke. The results were 19,450 c.ft. of gas per ton of coal. The gas used in heating the retorts was 2300 c.ft. (measured), which left available for sale 17,150 c.ft. per ton of coal. The sale of coke was 10·12 cwt., of tar and crude benzol 23·25 gallons, and of sulphate of ammonia (containing 24·75 p.ct. ammonia) 52·34 lbs. per ton of coal. These results were cash sales; there was no estimating. After Mr. Blundell read his paper at Manchester, he (Mr. Hislop) altered his method of working the producer to the plan suggested by Mr. Blundell, by giving unlimited primary air and throttling the producer gas duct. He found they got the heat up very considerably. Of course, the time was limited; but in four days they carbonized 59 tons of coal, with a make of 1,837,000 c.ft., or 20,640 c.ft. per ton. During this time, the average percentage of CO_2 was 4·2, and of carbon monoxide 16·4. The calorific power was from 450 to 460 B.Th.U. By carrying the experiment a little further, he got a make as high as something over 23,000 c.ft. per ton, with the calorific power increased slightly to about 470 B.Th.U. As to why he should use 4000 to 5000 c.ft. of gas instead of 2 cwt. of coke, it was simply a case of getting rid of the gas. For the four-and-a-half months before the price was increased 2s. 6d. per ton, they were getting coal at 16s. per ton, and securing 23s. for the residuals. The supposed local circumstances assisted in this to a certain extent.

The PRESIDENT said he did not know whether anyone else desired to continue the discussion; but time was getting on, and members would like to hear Mr. West's reply before having to leave the meeting. Therefore, it would be wise to close the discussion at this point; and in doing so, he would like to move a very hearty vote of thanks to Mr. West for the trouble he had gone to in bringing his valuable paper before the Association. There had recently been issued a report by the Board of Fuel Research; and in this report it was intimated that certain investigations were to be carried out which would be of vital interest to the gas industry. At the same time, in stating this, the hope was expressed that the investigations which a number of

* The table of results here referred to has been incorporated in the paper itself since it was circulated among the members.—ED. "G.J."

people apart from official investigators had been carrying on would be continued. He ventured to think that the contribution which Mr. West had given to the gas industry that day related to just one of those experiments which the Board of Fuel Research would welcome as a help. He felt confident that he could speak for the whole of the industry when he said they welcomed the research work which the Board intended to start. They were out for the economical utilization of coal, whatever that might be found to be. But in view of past experience and past experiments, and in view of what had passed that afternoon, it did not appear at the moment to be likely that the course adopted during past years by the gas industry, and which it continued to follow now, would be found to be uneconomical. If it were, they would have to alter their methods; but at present the case for any great alteration in their carbonizing plant seemed to be improved.

Mr. W. B. FARQUHAR (Ilford), in seconding the proposition, remarked that the matter had been so fully discussed by the various gentlemen who had spoken, that there was really nothing left for him either to add or to criticize.

THE AUTHOR'S REPLY.

The vote of thanks having been accorded with acclamation,

Mr. WEST proceeded to reply to the points raised in the discussion. The question asked about the amount of gas used was, he said, a very important one. He had not stated in his paper what quantity it took, though they had made many experiments in connection with it. He could, however, tell them that it was an admirable gas for heating the retorts; and that the working with such a gas was very nice and smooth. They kept their retorts regular day by day; and there was no doubt whatever that it was an excellent method of getting good and even results. But they must take into consideration that, when dealing with a plant which was arranged for producer gas of about 120 to 130 B.Th.U., it was rather a difficult thing to operate with a gas of 450 B.Th.U. It was found in practice that the dampers and other arrangements were not refined enough to regulate and mix the gas as he desired. This question was one which had to be worked out; and he intended to work it out. It meant that he would have to devise more refined means of regulating these two gases, so that he could mix them together in more minute quantities than it was possible to do with the ordinary gas plant. Mr. Hislop had told them that he used a nice lot of gas; and it paid him to do it. But there was no doubt whatever that in the experiments which he (Mr. West) intended to carry out, he would very much reduce the quantity found necessary in the last experiments, which was between one-fourth and one-third of the gas made. They had not been able to regulate it; it went away up the chimney. The gas he used was purified; but his friend from Uddingston used unpurified gas.

About the computation of costs, Mr. Doig Gibb could not quite agree, and was unable to see why labour charges were so much higher per ton when they were making larger quantities than when smaller amounts were being produced; and it was pretty well known, and was commonsense, that if they were obliged to do two days' work instead of one, it meant double plant and double men to work it. Under the coal carbonized experiments (Table I.), it took five times longer to produce less results than in the ordinary way. It only carbonized 0·81 ton per retort, when the ordinary way would deal with 4 tons per day. It needed five times as much plant, if it was desired to maintain the make; five times as many hours, and therefore five times as much labour; and five times as much everything, as far as he could make out. Unfortunately, he could not give Mr. Carr exactly what he wanted; but they did know that they were not producing so much toluol and benzol as when working horizontal retorts. If, however, they did not produce this, they produced something else—tar oils, and more paraffins, which were perhaps not exactly what the Government wanted so much at the present time, though fuel oil, he believed, was urgently required. Mr. John Bond and Dr. Perkin, who had been responsible for working out these experiments, had all these things at their fingers' ends—especially Mr. Bond, who, unfortunately, was unable to be at the meeting. They could not work these tars, &c., up at the St. Helens works, because they were operating there with three systems—their experimental plant, a large installation of horizontals, and a bed of inclines. All the tar had to go into a common well; and the only way they had of getting out results was by the distillation of the tar which went to Southport to be tested on a large practical scale, and which was still being tested there now. Mr. Blundell, who was with them that day, could, he believed, give the figures he had himself got out on similar verticals at Macclesfield. There were more tar oils and ammonia.

Then Mr. Carr had spoken about the big waste of coal that was going on at the present time through the presence of inert material. This trouble was an appalling one. The percentage he had given them was small in comparison with what he had obtained from his friends. The matter ought to be grappled with. So long as they continued to permit people to send them this coal, so long would they go on doing so. They were not picking it, and therefore were putting the money into their own or somebody else's pockets. Mr. Gill had spoken strongly about this, and had given some vivid illustrations. He himself could give them one, in connection with a brick-works. The manager there said that he wanted a lot more room, because he could find no place in which to put all the rubbish and clinker from the coal. It was costing more than before to make the special bricks which the Ministry of Munitions were urgently needing. Dr. Colman spoke on the economic question, and pointed out that they wanted larger yields of oils. He also indicated the difference between the fuel oil which they obtained from verticals and horizontals. The verticals had it one way, and the horizontals perhaps another; and they were all doing the best they could for the country. Sir Arthur Duckham had hinted that someone was going to look after them for the future. Well, they wanted some looking after. They did not want sympathy, but help—help from the Government, if they would give it to them, by legislating in a proper manner. Mr. Glover referred to the cost of steam, which was very important. This was another matter with which they were experimenting, and with which there had been a little difficulty. He had intended to tell them how these experiments were worked out, which was in the ordinary way, so far as stokers were concerned. There was not sufficient work on this small plant to keep one man going, so it was linked-in with the ordinary retorts. They had nothing to do with the stoking. If he had to undertake the experiments again he would certainly have special men for the purpose, let the cost be what it might. He was quite satisfied that the results he had laid before the members were minimum ones, and that with closer supervision of the plant better results might have been obtained.

[At this point, Mr. West was compelled to make a brief pause in his remarks, owing to a total failure of the electric light. The turning on of the gas, however, soon enabled him to proceed.]

As to Mr. Glover's question about the cost of coke and steam, he (the author) had put this very point to Mr. Blundell, who had most carefully worked it out in connection with his own experiments. Let them take Mr. Blundell's figures in preference to his—which he might say were less than Mr. Blundell's. He (Mr. West) used less coke; but he would rather rely upon Mr. Blundell, because his experiments continued over a much longer period. Mr. Blundell gave the loss in coke for sale per ton of coal carbonized as: (1) Carbon converted into water gas in the retort, 25 lbs.; (2) extra fuel supply to the producer to effect the water-gas reaction, 25 lbs.; (3) fuel supply to burners to generate steam, 24 lbs.—total, 74 lbs. He (Mr. West) would say himself that in practice it would come to about ½ cwt. per ton of coal carbonized. The cost for labour did not enter into the calculation with the vertical retort; but in the case of a separate generator, Mr. Blundell worked the labour out at 0·63d. per 1000 c.ft. Coke for the generator, 39 lbs. per 1000 c.ft.; and for the boiler, 11 lbs.—or a total of 50 lbs., which, at 1s. 2d. per cwt., equalled 6·25d., or, with the labour, a total cost of 6·88d. per 1000 c.ft. This was, however, a matter which those who had verticals and blue water gas could test for themselves.

Mr. Arthur Valon pointed out that stripped gas was partially known before; and he himself had done something in this matter. He did not quite agree with working the cost out in the way that had been done, on sperm values. Well, it did bother him (Mr. West) to decide how he should do it. It was a bit old-fashioned perhaps; and being a little old-fashioned himself, he could not think of anything better. But Dr. Colman told him that he had been trying to work it out in another way; and he had come almost to the same thing. Practically, they were agreed; so that, for the purpose, he contended that his own method was all right. It was, of course, comparative. The question of the best quality gas to produce was one that had to be settled; and he was about to do it himself on a very large scale. He was going to test some big engines with different qualities of gas, and put the brake on, and see actually what horse power he could get. All these things would take time, but would have to be done; and they would get on with the work as fast as possible.

Referring to the inert question, he had been asked to make a calculation; but he did not know how many decimal points it would have to be worked out to, in order to ascertain what would be the effect of 1 p.ct. of dilution on a gas of 500 B.Th.U. He did not quite know this. But he did know that a gas diluted with inert matter did not give the same flame temperature as one free from it, and that the heating power of gas with a good flame temperature was considerably better than that of a shorter flame where inert gas was pretty prominent. He was told that this question would undoubtedly have to be settled very soon. The Government were making a special study of the matter; and they would not be able to get the calorific standard throughout the whole of England, unless the problem of inert matter was also dealt with. There would certainly be a restriction, though what the restriction would be he did not know. Figures had, however, been suggested to him which, if they were imposed, would, he was afraid, make some of them "sit up." They needed rational, calm, and deliberate consideration of this question. He did feel that they wanted, not only to pay their dividends, but to please their customers, and give them good gas which they would thoroughly appreciate, and which, he was sure, would eventually be the means of causing gas to be much more widely used than hitherto.

THE QUESTION OF RESEARCH.

One other point with which he wished to deal was the question of research. He was pleased to find that Sir George Beilby had brought forward a proposal, which he (Mr. West) looked upon as part of a general scheme. His idea, and that of many others with whom he had discussed the question, was that a wide and comprehensive scheme should be laid down for carrying out scientific and practical working research experiments simultaneously throughout the entire country, more especially in the chief centres of commerce, where chemical and engineering works were already in existence. They ought to utilize to the full extent all the principal Universities, which he would say were built for this special purpose (for instance, there was the Victoria University, of the City of Manchester, where there was also the largest and best-equipped Technical School in the kingdom), with their large staffs of professors and highly-trained technical assistants, who were well qualified for carrying out this kind of work. It was only necessary that the Universities should be co-opted, and that a strong Committee should be formed from these Universities, on similar lines to those of the Ministry of Munitions, who had utilized the whole of the gas industry, and the chemical and engineering works, besides a large number of railway engineers, for war purposes. Then, if the Government would pay the expenses of the chief operators of the experimental plants, there was no reason at all why these gentlemen could not commence to work at once, as there were plenty of modern works and plants in existence which could be utilized. Operations could be started with the minimum of preparation and expenditure. Many private firms and scientific and practical men would, he was sure, be willing to render help and give their services, as some of them were now doing, to carry out this important work for the benefit of the country. He strongly held the opinion that, if they were to be successful in maintaining their position against German competitors, they must properly prepare themselves without loss of time, and follow the examples of the larger private undertakings, and proceed with a will and determination to accomplish and put on record something in this most important and vital field of research. If the advo-

cates of low-temperature carbonization were not satisfied with the large results of high and low temperature carbonization that he had laid down before them, he would suggest that, if the "powers that be" were seriously intent upon making an investigation of national importance, this could be very quickly and thoroughly and inexpensively conducted by utilizing existing plants. They could use the experimental plant where these experiments had been carried out, and other plants that were in existence, where many tests could be made at high, medium, and low temperatures, all of which could be conducted under a comprehensive programme drawn up and supervised by a small committee of independent experts, and initiated and carried out at once. His motto was: "Get to work, and do not talk." The watchword should be "Up and do."

VISIT TO THE PAISLEY GAS-WORKS.

On Saturday afternoon there was an excellent turn-out of members of the Scottish Junior Gas Association (Western District) for a visit to the Paisley Gas-Works; about fifty being present. The party was met at the works by Mr. Geo. R. Hislop, the Engineer and Manager, and his Assistant, Mr. Nesbit, who conducted them round.

The four De Brouwer chargers created great interest, also the absence of drawing machinery; all the drawing being done by hand. After leaving the works the party was conducted to the new meter shops, which are situated in the centre of the town. These having been inspected, the company was entertained to tea in the Café Riche by the Paisley Town Council.

Bailie GEORGE HENDERSON, the Gas Convener and Senior Magistrate, in welcoming the members, said he hoped much useful information had been gained during the round of inspection of the works.

Bailie JOHN GLOVER, the Vice-Convener, supported the welcome, and hoped that in the years to come the Association would again visit Paisley.

Mr. HISLOP then addressed the members. After informing them that he had had seventy years' experience in the gas industry, he went on to speak of present-day difficulties under which all gas making was carried on—scarcity of labour and the high cost of necessary materials. Comparisons were drawn between the disposal of tar now and in his earlier days, when a 120-gallon barrel of tar was sold for 1s. 6d. Even at this low figure it was sometimes impossible to dispose of it, and many a gallon found its way into quarry holes and other more or less convenient places. Nowadays every drop is valuable for war purposes.

The PRESIDENT (Mr. Alec. Wright) returned thanks on behalf of the Association, and said they had had a very enjoyable and instructive afternoon.

Before leaving, sympathetic reference was made by the visitors to the losses sustained by Mr. Hislop and Bailie Henderson in the present war; Mr. Hislop having lost one son killed in action, and Bailie Henderson two sons. Through the kindness of Bailie Henderson, the members had the privilege and honour of seeing the two decorations won by one of his late sons—the Victoria Cross for great bravery at the Battle of Arras, and the Military Cross gained on the Somme.

The Tungsten Lamp Litigation.

The long-drawn-out litigation between the Osram-Robertson Lamp Works, Ltd., and Pope's Electric Lamp Company, Ltd., has come to an end; and the lamp makers are breathing freely again—at all events, those are who work in association with the Osram people, because the final success of the Pope Company would have ended once and for all the Osram Company's claim to a supreme monopoly. The Pope Company were the winners in the Chancery Court and the Court of Appeal; and it looked much as though the Osram Company would have to take a back seat in the House of Lords. But they have found the House highly useful in the defence of their position; and they at all events will have no cause to demand its abolition. At the same time, they have not the satisfaction of having secured a complete victory, inasmuch as it was only by a majority of one out of a tribunal of five that they succeeded with the final appeal. The two lower Courts being against them, and two out of five judicial Lords, they have not exactly made a clean sweep of their opponents. The principal point in dispute had reference to part of the specification of Just and Hanaman's patent under which they manufacture. This part provides for the removal of the carbon (which in the process serves as a binding medium) from the tungsten filaments, by subjecting them to the passage of an electric current in a steam and hydrogen atmosphere, thus raising them to a high temperature. The appellants admitted that, unless it could be shown that the process of the respondents in substance consisted in the application of an atmosphere of steam and hydrogen, they could not succeed. The respondents it appears apply external heat, and do not make any provision for an atmosphere of steam and hydrogen. But the Lord Chancellor and two of his noble and learned colleagues are of opinion that the application of heat would in its action upon the filament form a sufficient atmosphere of steam and hydrogen to effect the purpose. With all deference, this seems to be a bit far-fetched; but as a majority of their Lordships say it is so, it is inevitable that other people's opinions must bow to theirs.

SUGGESTED COMBINATION OF GAS AND ELECTRICAL ENGINEERING.

Last Thursday the President of the Institution of Electrical Engineers—Mr. C. H. Wordingham—delivered his inaugural address to the members; and in the section of it dealing with "Economy of Fuel" he remarked:

Closely connected with the problem of power supply is that of national economy of fuel. Partly from the bitter experience of war, and partly, perhaps, from contact with our glorious ally France—one of the most economical of nations—we have begun to realize the necessity of not wasting our irreplaceable national asset. There is a tendency to confuse economy of fuel with cheap power supply; but the two are quite distinct, although closely connected. I venture to think that, in regard to these matters, electrical engineers have been apt to arrogate to themselves too prominent a position. It is little short of ludicrous to ignore the great gas industry either in respect of their consumption of coal, or of the experience of their engineers and managers. While for motive power and lighting, and for certain kinds of furnace work, electrical operation is pre-eminent, and will almost certainly in the fullness of time be universal, there will still be an immense field for heating by gas. Apart from this, however, I hold most strongly that gas production will be an intermediary between the raw fuel and the live steam, and so be concerned in the generation of the whole of the electrical energy used. I have for many years advocated the close co-operation, if not the fusion, of gas and electric interests; and I believe an appreciation of the soundness of this view is gaining ground.

It is to the national interest that the maximum useful result should be obtained in dealing with the fuel, even though the greatest amount of electrical energy may not be obtained from each pound of fuel that could be extracted. It would be folly to forgo the manufacture of those bye-products and their derivatives which give rise to whole industries; and it is here the enterprise and skill of the chemist and of the gas engineer and manager come in. If each expert keeps to his own domain, the greatest good to the nation will ensue. The whole of the coal raised should be treated as near to the pit as practicable for the extraction of the substances usually referred to by the generic name of bye-products, and for the production of fuel—whether solid, liquid, or gaseous, or one or more combined—which can be conveniently used for the direct production of steam. At this point, the electrical engineer should take the matter in hand and produce his steam and conduct the other operations necessary to provide the electrical energy for transmission at high pressure to the distributing centres.

LINE OF DEMARCATION.

I do not think the proposal which has been made is sound, to draw the dividing-line later and let the gas-works supply the steam. Electrical engineers have made the production and utilization of steam their own field, and they are pre-eminently expert in it; while gas engineers have not been called upon to consider this problem to any great extent nor under the conditions imposed by a generating station. Moreover, I think there would be practical operating objections to this line of demarcation.

POSITIONS FOR GENERATING STATIONS.

In the new circumstances it is obvious that the sites of generating stations will be determined in future solely by the facilities for carrying on the operations named, and will be uninfluenced to any material extent by their proximity to centres of demand. The only way in which the interests of fuel economy and efficient distribution can be reconciled is by the use of extremely high pressures of transmission and by other means for the reduction of the cost of mains. Even so, it may well be that the cheapest—as distinguished from the most efficient—supply of a given quantity of energy at a given point may not be realized; though, on the whole, the most economical use of the fuel will have been made.

SUPPLY OF HEAT.

The problem of the production of heat in detail, to supply a distributed demand for warming buildings and for cooking purposes, will require careful study. The present crude methods are cheap, simple, and to a large extent convenient; and, so far as the heating effect is concerned, as distinguished from the effect on the atmosphere of towns, agreeable and wholesome, but they are criminally inefficient.

Electric cooking will probably be very largely used, on account of its intrinsic merits. Improvements in cooking appliances have already been effected; and, with increased demand, we may look forward to robustly designed and simple appliances that can be handled without damage by the ordinary domestic servant, and that will be sold at prices comparable with those of the articles displaced. Electric heating of rooms will also have a large field in those cases in which convenience is an overwhelming consideration—such as in rooms used only occasionally, or a few hours a day. I do not believe that electric heating will be employed for steady all-day heating, or for boiling the large quantities of water required for domestic and trade purposes, because it will never be cheap or economical to do so. This heating will probably be done to a large extent in the smaller houses by gas or by some solid fuel produced in the gasification of coal. In large establishments, blocks of offices, factories, and all large buildings,

some form of central heating in which the heat is produced by solid fuel of the kind I have indicated (or possibly by liquid fuel) will very probably be introduced, on the grounds of cheapness and economy, though certainly not of comfort or health. If gas be used extensively for heating, new problems in its distribution will have to be faced eventually, arising from the concentration of gas production in centres often distant from the area to be supplied. For a long time to come, however, many existing gas-works will continue to produce gas and bye-products, and possibly (where conditions are favourable to steam operation) contribute their quota to the electric supply, just as will continue to be done by stations run by blast-furnace gas.

REMOVING BENZOL FROM GAS.

The "Chemical Trade Journal" for the 3rd inst. had an abstract translation of a paper by M. Leonce Fabre, of the Marseilles Gas-Works. Writing in the "Revue Générale Chimie," he describes the Grœling, Gasser, and Feld processes for the removal of benzol from gas.

In the Grœling process the gas is first cooled; and the benzol is then absorbed, extracted, washed, and rectified. Absorption is effected by means of four columns provided with the necessary pumps, tanks, and pulverizers. The saturated oil is conveyed to a tank placed above the stills, into which it is introduced after having passed through a reheater which utilizes the heat of the vaporized benzol. This distillation apparatus is heated by means of steam-coils. The benzol vapours pass through a dephlegmator; and the temperature is kept up so that the vapours pass into the cooler and are condensed. The benzol-free oil, after distillation, is cooled-down to 20° C., and is again used in the columns. The crude benzol is collected in a tank which feeds a series of washers. There are two such feeding tanks; four tanks for the acid, one empty; two for the caustic soda; and two cylinders for the water, together with the necessary fittings.

The continuous washing process is as follows: The benzol from the tanks passes into the first feeding tank or vat, passes over a layer of acid and into the second vat, and thence into the empty vat, where it is left to stand for a time in order that any acid carried along may separate-out. The benzol then passes into the soda tank, and finally into the water tanks. This method has the advantage that it requires no stirring; and consequently there is no loss of benzol by evaporation. Moreover, the space required, also the labour, are much less than when stirrers are used.

In small plants the rectifying apparatus consists merely of a still with a coil inside either for direct or indirect heating; a dephlegmator, with steam heating in the lower part; and two condensers in the upper part. Suitable valves are provided for removing the various distillation products at the different levels. The 90 p.ct. benzol, 50 p.ct. benzol, and naphtha are obtained by means of three different dephlegmators. Grœling's method is thus continuous, and is said to be very economical in regard to plant and labour.

It is, of course, well known that a washing-oil saturated with benzol requires less heat for setting free the benzol than an oil which contains less benzol. It is, therefore, desirable to obtain a temperature which increases in proportion as the benzol content decreases. Moreover, distillation is more complete if the oil is heated in thin layers. It is on this principle that the Gasser process works. The saturated oil first enters into a tubular heat exchanger, and is heated by the benzol vapours and steam coming from the stills. The oil then passes into a second heater, which acts at the same time as a hydraulic seal or closure for the still, and in which heat exchange is effected by the hot benzol-free oil coming from the stills. The oil then passes into a third reheater, consisting of cylindrical elements provided with superheated steam coils, and passes thence into the distilling apparatus. This consists of a number of cylindrical elements furnished with steam-coils and jets. The coils maintain the necessary temperature, and the jets remove the benzol. After leaving the stills, the oil passes through the reheater above described, and after cooling it is conveyed to the column. On the other hand, the mixture of steam and about 50 p.ct. of the benzol are conveyed from the still into a dephlegmator, the surface of which consists of cylindrical cells; and thence into a second dephlegmator consisting of three tubes filled with coke to absorb the last traces of oil. The mixture next goes into the oil-reheater and finally into a cooler where it is cooled down to 20° to 25°. The water and benzol are then separated in the usual way. Several advantages are claimed for this method—*e.g.*, the small space required and the easy accessibility of the plant.

In the Feld process, which is described at some length, the chief feature is the use of several washers—eleven in number, of the Feld type. The process, according to the author, appears to be of doubtful utility; and although he gives numerous details, he states that the results vary considerably in different gas-works. The absorption of the benzol by the washing-oils is not always satisfactory; and the cooling of the benzol-free oil is not always sufficient before using in the washers. Moreover, the quantity of oil in the washer is such that its temperature tends to equal that of the gas, even if this latter has a temperature above 15°—giving rise to conditions unfavourable to maximum absorption.

The best results are apparently only obtained by the modern method of atomizing or spraying the washing-oil. This method, carried out by means of "Excelsior" washers, permits the vaporized oil in the form of a mist to be intimately mixed with the gas current; and since the washing-oil is gradually removed from the gas mixture, it is easy to cool it by placing the suction and pressure pipes from the pumps in a cooling tank containing cold water, or by means of brine.

GAS FROM STRAW.

The following account, from Prof. R. D. M'Laurin, of the Department of Chemistry of the Saskatchewan University, of how useful fuel can be obtained by carbonizing straw refuse, is taken from the pages of the "Commercial Motor."

The matter of producing gas from straw refuse is of considerable importance to Canada, because, on the prairies, there is no wood, and the average price for either hard or soft coal is very high. Again, there is a large amount of straw which simply goes to waste; and every autumn the straw is burnt and is regarded as having absolutely no commercial value whatever.

In order to deal profitably with this straw, Mr. George Harrison, the Manager of the Saskatchewan Bridge and Iron Company, of Moose Jaw, Saskatchewan, has invented a retort for carbonizing it and any other cellulose material, thereby decomposing it into combustible gases, tars, and ammonia, with a carbon residue; Prof. M'Laurin having undertaken the chemical work in connection with the development of the project. A number of experimental plants have been made, and it is hoped to get them installed on a certain number of farms during the present winter.

The uses to which the farmer can put the products of combustion will be for lighting, heating, and power in connection with his farming operations, and also in connection with his household. Professor M'Laurin suggests that, as most of the farm work in Canada is done with tractors, there can be no reason why a couple of retorts should not be placed on a tractor, so that a constant supply of gas can be furnished to a gas-container while the tractor is in operation. In order to reduce the size of the retort, negotiations are at present being entered into with regard to a baling machine which will press the straw into the shape and size of the retort, and to such a density that a bale cubing one foot will contain 25 lbs. of straw.

The retort is made out of highly refined steel, and is designed in such a shape that the gases are removable in a very short time. It is also designed for individual use on the farm, and is of small dimensions. The retort consists of three oval cylinders, 7 ft. 6 in. long, with a major axis of 24 in. and a minor axis of 6½ in.; the retort being enclosed in a metal or fire-brick casing with a fire-box below. With a scrubber and a gasholder, the total cost in Canada, including installation, is expected to be $500 (about £105).

The straw, compressed into bales the size and shape of the retort, is placed in it; the doors are shut by a clamp; and straw is burnt in the fireplace below. After the operation, when straw is used as fuel, a certain proportion of the gas given off is used for the purpose of the carbonizing process; about 30 p.ct. of the total volume of the gas being utilized in this way. The gas begins to come off at a temperature of 200° C., and reaches its maximum between 500° and 600° C. All the gas may be removed from the straw in about 30 to 45 minutes; rapidity of operation being an important factor from a commercial standpoint.

Each ton of straw produces between 11,000 and 12,000 c.ft. of gas; the quantity and quality of the gas varying slightly from different kinds of straw. The gas, after generation in the retort, passes into a scrubber (this being a metal cylinder 4 ft. long by 18 in. to 24 in. diameter), and thence into the gas-container or flexible bag. If the gas is washed and purified so that the volume is reduced to 10,000 c.ft., and, as stated above, 30 p.ct. is utilized in carbonizing a ton of straw, there would be a surplus of 7000 c.ft. for every ton of straw carbonized. The calorific value of straw gas is approximately 400 B.Th.U. per c.ft.; so that a ton of straw would contain 4,000,000 B.Th.U. In this country, it is reckoned that about 250 c.ft. of coal gas is equal to a gallon of petrol; and the thermal value in B.Th.U. of a gallon of petrol is calculated in the United States at approximately 114,000. In this country, a higher value is given. Taking 7000 c.ft. as the net output from a ton of straw, the heating value of the gas from this quantity would be 2,800,000 B.Th.U., which can be taken as equivalent to 25 gallons of petrol.

From every ton of straw there is obtained from 6 to 8 gallons of tar and ammoniacal liquor. The tar in its crude state would pay for the cost of baling the straw, which may be approximately put down at 4s. 6d. a ton; so that the farmer would have his fuel prepared ready for use at the cost of hauling it from the field to the retort. The carbon residue (of which there is about 600 lbs. to a ton of straw) would find a ready sale as lamp-black or (in this country) as manure.

On the 20 million acres which are cropped annually in the three prairie provinces of Western Canada only, and giving a yield of a ton of straw per acre, there is a total yield of straw of 20 million tons. Allowing for washing and purifying, and for the use of about 30 p.ct. of the gas for the purpose of carbonizing the straw, there would be procurable 140,000 million c.ft. of gas, which may be taken to be equal to 22 million million H.P. hours.

With regard to the durability of the retort, it will be observed that the straw is carbonized at the comparatively low temperature of 500° to 600° C.; and it is well known that good steel or wrought iron will withstand such a temperature practically indefinitely.

A final word with regard to the gas itself. It is found to be utilizable in exactly the same way as coal or natural gas. The constituents are methane, hydrogen, and carbon monoxide. It has a slight odour, and has been found quite suitable for incandescent lamps, stoves, grates, and furnaces.

It must be realized that conditions differ so materially in different countries that a scheme which may be feasible in Canada would not have the least ground for success over here.

GAS FURNACES: THEIR DESIGN AND MANIPULATION.

By ARTHUR FORSHAW, M.Sc., Chief Chemist to Messrs. John Wright & Co., of Birmingham.

[A Lecture delivered to the Manchester and District Junior Gas Association, Nov. 2.]

I believe that no subject could be of greater importance to-day than industrial gas appliances—alike to the designer and manufacturer, to the user, and to the gas industry which supplies them with fuel; and this prominent position is due to the width of range, and the rapidity with which they can be applied to the solution of the fresh problems that are daily arising out of war needs.

My object in choosing this subject of gas-furnaces is to try and give you, as gas engineers, information as to the types of furnaces in use, the processes for which they are used, and the underlying metallurgical reasons prompting each particular heat-treatment with its appropriate furnace.

Information of this sort can hardly be obtained from catalogues, nor, so far as I know, from any published communications in the Gas Press. It is an interesting subject to myself; and I offer the following remarks in the hope that it will be no less interesting to the members of your Association. After all, as far as regards coal gas, your members are concerned even more than the furnace makers, seeing that it is your interest to ensure the adoption of the best types of apparatus and so secure a continual source of income.

CRUCIBLE FURNACES.

No furnace has made greater strides in the last few years than the crucible melting-furnace. Although gas-fired crucible furnaces have been on the market for a number of years, it is safe to say that only within the last four or five years has gas-melting become a commercial proposition; and, indeed, gas-melting as such has so far only touched the fringe of the business. The great bulk of metal in this country is still melted by coke. In a recent paper it was stated that the best pit-type coke-furnace melting brass has a thermal efficiency of about 5 p.ct. Even this low figure is a great improvement on some of the earlier types of coke-furnace. For instance, what I might call the old original square coke-furnace had an efficiency in the neighbourhood of 1 p.ct. The usual way of rating coke-furnaces is by the weight of fuel consumed, expressed as a percentage of the weight of metal melted. In the best pit-type of to-day this figure is about 30 p.ct.—*i.e.*, between 6 and 7 cwt. of coke per ton of brass; while in the original square type above mentioned it ran as high as 150 p.ct. This low efficiency was due to the fact that the lining of the furnace was merely done by the bricklayer according to his own ideas, and without reference to drawings. Obviously, the consumption of coke in such instances is only limited by the width of the fire and the strength of the draught. As the latter may vary from day to day, so the efficiency and output would also vary. High as this consumption is, there was a type of furnace which eclipsed it. It consisted of a large chamber holding four to six pots. These were surrounded with, and buried in, coke. The top of the chamber contained a flue. Access to the pots could not be obtained once the fire had started; so, in order to get full charges of molten metal, they were piled-up high with the ingots or scrap, which was thus in direct contact with the coke. Under these conditions the fuel consumption was about 300 p.ct. of the metal melted; while the latter, owing to its exposure to gases and coke, contained much oxide and sulphide. In the most modern pit-type coke-furnaces, when the lining requires renewing, the old one is chipped-out and a complete lining in one piece inserted. In this way, the furnace always starts with its new lining of the correct size. Several furnaces of this type are connected up to one common flue; the draught to each being controlled by the opening left for the purpose in the lining. Fuel consumption is reduced by the use of special bars which also allow of the easy withdrawal of clinker. Without some special arrangement of this sort, bars become clinkered-up, with the result that uneven burning of the fuel takes place. Nearly all the best pit-furnaces are built square. This creates a sort of reservoir of fuel at the corners, and also allows any extra large lumps of coke to be raked into the corners without any liability of damaging the pot by forcing them down a circular combustion-space of constant dimensions. Further, it allows of easier introduction of the tongs. These advantages have to be weighed against a slightly greater efficiency for round furnaces—providing the coke is graded properly. Such, in brief, are the coke pit furnaces against which gas has to make headway.

There remain, however, the coke tilting-furnaces; and these are dangerous competitors in their own way, for they attain a thermal efficiency of approximately 15 p.ct.—*i.e.*, they require only one-third of the coke needed by the pit-type to do the same work. This leads me to a very important point, and one which I wish to emphasize. It is that we see far too much attention drawn to the consumption of fuel, and too little to other factors which enter into the melting of metals. It might be argued that as you are concerned in providing the fuel, this factor is of transcendent interest to you. This is true. But unless the apparatus to which you supply fuel is satisfactory in regard to the other factors, your market for fuel will soon disappear. It is, of course, the manufacturer of the gas-melting furnace to whom you must look for satisfactory apparatus; while he, on his part, must look to you for fuel which can compete with its rivals.

Passing on to discuss the other factors, we can briefly comprise them under the headings of linings, crucibles, labour, and rate of output.

FURNACE-LININGS.

With regard to linings, we are faced with the fact that when furnaces come to be lined, the ordinary coke-furnace costs less than the gas-furnace, for the reason that in coke-furnaces a lower class of refractory can be used than in gas-furnaces. In coke-furnaces, the bricks are in contact with the coke. They are also subject to corrosion from the ash, and to erosion due to the continual rubbing of the coke as it passes down the combustion space, and therefore, to enlargement of the latter. But up to a certain point this does not matter much. It raises the fuel consumption somewhat; but in normal times coke is comparatively cheap. In the gas-furnace, on the other hand, the combustion space must be kept constant within narrow limits, or the consumption of comparatively costly fuel rises materially. All the time, however, unless care is taken, the lining of a gas-furnace is subjected to the effects of any metal which may be spilt over the sides of the pot or during charging. The action of such spilt metal is very destructive. The metal first oxidizes during the time the gas is off for the pouring, and the basic oxide produced afterwards attacks the acid brickwork, with resultant formation of slag. This, of course, increases the combustion space; while if the slag be not removed at sufficiently frequent intervals, it may make its way up to the burner level, and either deflect the flame or completely block-up the burner ends.

Again, unless certain precautions be taken in designing the furnace, the same thing may result from the slag running down the furnace wall and dropping on to the burner. To prevent such blocking of the burners, we have tried burners at the top of the furnace; but so far the disadvantages appear to outweigh the advantages. I can say no more on this point, as the experimental work is still proceeding. It follows that the linings should be selected with a view to resistance not only to heat, but also to slag corrosion. Our experience is that most of the spilling of metal is due to careless stirring; and as it is too much to expect that this will ever be entirely cured, it is essential that the gas-furnace be provided with means of removing any slag formed in this way. If it be not removed, the corrosion of the remaining brickwork is much facilitated. In a case where slagging was neglected, I have seen the slag form a pool reaching to a higher level than the top of the pot-stand; while the shape of the furnace from cylindrical had become nearly spherical. Under such conditions even if the burner be not interfered with, the gas consumption may easily double or treble itself. Attack by slag on the linings is much accelerated by temperature, so that the higher the temperature at which the metal must be poured, the greater the care that must be exercised in trying to exclude spilt metal. There is another aspect of the spilt-metal question in relation to temperature that is of special importance to gas-melting.

INCREASED OUTPUT WITH THE GAS-FURNACE.

One of the points in favour of gas-melting, as compared with coke, is the possibility of increased output by the former for a given size of plant. This increase may be a very substantial one and amount in some cases to 100 p.ct., though more frequently it will be found to range from 50 p.ct. upwards. Parenthetically, it may be pointed out that increased rate of output means that to reach a given figure, less plant is required, and therefore less capital outlay. To obtain this increase, however, necessitates, among other things, raising the temperature of the combustion space, because the increased flow of heat necessary through the walls of the pot to obtain the output is, of course, made possible by what I may call an increased "head" of heat—*i.e.*, higher temperature; and so again the greater the output the greater the care that must be taken to exclude spilt metal. That temperature itself is not sufficient to damage our linings, we proved by running one of our large "Lip-axis" tilters without any metal in the pot for a week continuously—stopping only for short periods to represent the ends of the normal shifts. Under these conditions, the temperature was raised very much above anything that would be experienced in practice. The lining, on examination, proved to be in practically the same condition as at the start of the test, and quite without signs of fusion or running, except in one place which was not due to failure to withstand the temperature, and which made the experiment still more valuable—viz., a small piece of iron lodged on the brickwork melted by accident. At the high temperature of the furnace, this had run down the furnace wall and cut a channel in the surface of the lining right from the top to the bottom, where it had finished up in the form of slag.

THE SLAG DIFFICULTY.

To return for a moment to the preservation of linings. I have mentioned that suitable means must be provided for getting rid of the slag at frequent intervals—how frequent depends on the care taken by the man in charge of the furnace. In some cases, it must be done at the end of each shift; but with proper attention during charging and stirring, it should not be required so often. It has been the practice to try and get rid of the slag by leaving a hole in the lining at the bottom of the combustion space, communicating with a channel leading outside the furnace. This arrangement, however, is useless. The slag formed is so viscous that it will with difficulty flow into the hole. If it does get there, it solidifies immediately it is out of actual contact with the flame and the hole becomes blocked. The solidified slag must then be chipped out; and in the doing of this the hole becomes enlarged. In the result, the slag is not satisfactorily got rid of; the furnace lining is damaged by the chipping; and loss of heat occurs through the hole. To improve on this, we introduced a furnace bottom consisting of two semi-circular iron doors hinged on the outside and closing on to a bridge. When open, the furnace had a full through-way into the pit, except for the bridge, and the slag could be knocked down from above while still hot. The doors, before closing, were covered with fireclay. They were held in the shut position by means of iron wedges, which have to be knocked out from underneath before they could be again opened. When closed, the pot-stand rested directly on the firebrick bridge, which in turn was supported by a cast-iron or steel strap—the pot, of course, resting on the stand. Sometimes the space between the stand and the furnace wall was filled with broken brickwork. Since then, experience has shown that this method of holding the doors could be bettered, and our present pit furnaces have a wheel and shaft at the side. By turning the wheel which projects above the floor level, the bottom can be dropped without going down into the pit to remove wedges. When it is closed, the wheel is kept in the correct position by means of a ratchet and pawl.

LIFE OF LININGS.

We are often asked what life may reasonably be expected from a furnace lining; and we are bound to reply that "it depends." It is, in the first place, difficult to get definite figures; for we are, as a rule, not in a position to follow the performance of a furnace in an outside foundry for a long enough time. Sometimes one sees estimates of (say) six months or a year; but time in this connection conveys no meaning. We prefer to calculate on the number of melts obtained; and this will, of course, depend on the quality of brick. The users should be guided by the furnace manufacturers in this matter. A figure of 500 melts for small pit furnaces melting gun-metal or brass is not unreasonable; and with care there is no reason why this should not be as high as 800 melts, particularly for brass, while for aluminium it should be considerably more. The more often the lining is "fettled," the longer will it last. Naturally, the quicker the rate of output, the greater the wear and tear on linings. On the other hand, continuity in melting makes for economy, as every time the furnace is cooled-down and reheated, there is extra wear and tear of the linings. It is well worth considering the expedient of paying furnace operators a bonus on the life of the linings. This general question of getting large outputs at the expense of frequent renewals of plant has been discussed in connection with many different sorts of apparatus and machinery, and can only be decided after experience. In general, it would appear that speeding-up production pays; but each furnace must be specially designed for the particular purpose in view. For instance, a cupro-nickel furnace is supplied with much increased burner power, and is more perfectly heat-insulated; and such a furnace would not be economical to use for brass. On the other hand, a furnace designed for brass would hardly get cupro-nickel to a sufficiently high temperature; and, if it did, the general melting cost would be unnecessarily high.

CARE OF CRUCIBLES.

Having dealt with some aspects of crucible furnace linings, I will pass on to discuss the second factor mentioned, which was pots or crucibles; and this again may be a serious item unless due care is taken. It does, however, repay attention; and a few notes will help to show in what directions to work for the best results. In the first place, a new pot should be carefully annealed immediately prior to use—14 days steady annealing at 150° C. is not too much. This, of course, applies to crucibles for coke or oil furnaces also. It helps very greatly if the pots are stored in a warm, dry place—*e.g.*, firms who, in addition to brass melting, do their own rolling and annealing, find the top of the annealing ovens a convenient place; while foundries often store the pots in core-ovens, which is good practice. Such procedure can take the place of the annealing mentioned above; the main idea being slowly to get rid of all moisture in the material of the pot. Should this not be effected, the pot will probably "bump"—that is, a piece will flake off from the wall and render the rest of the pot useless. This may happen at any time during the first heat, where annealing has not been properly done. Usually, if the pot survives the first heat, it will last for its normal life

I will now take some further points affecting the life of crucibles. In gas-melting, the correct setting of the gas and air in relation to one another is primarily made in order to effect the most economical melting; but another reason for taking particular care of the quality of flame is that the crucibles are made of a mixture containing a large amount of graphite. There is no need to dwell on the effect of an oxidizing flame on such material. In short, the graphite is burned away, and the pot loses its strength. The same effect may be observed more locally if the burner is of such design that the air jet can play on to the pot before being properly mixed up with the gas. The effect in both cases is to cause the pot to scale—flakes of clay-work, from which the graphite has been burnt out, come away from the sides, and the pot is very soon useless. This effect is often produced by fluctuation of gas pressure. The flame may be set correctly in the first place; later on the gas pressure may drop, and in a few minutes the damage is done. In one case I came across, the average life of the pots was increased by five melts simply by installing a good gas-governor. Another cause of this flaking or scaling is when, owing to neglect of slagging-out, a partial stoppage of the burner orifice occurs. This throws a back-pressure on the mixture of gas and air, with a consequent decrease in the amount of gas injected by the air, which latter, being under positive pressure, is scarcely interfered with, and thus becomes in excess. Scaling of crucibles, it should be noted, is also generally an indication of oxidation troubles in the metal.

CORROSION BY FLUXES.

A further cause of short life of pots is occasionally met with, and that is corrosion on the inside of the pot at the level of the molten metal. This is due to the action of fluxes. At present, it is a matter of controversy as to the exact reactions occurring, because some fluxes appear to attack gas-heated crucibles more than coke-heated ones, and others *vice versâ*. At all events, the trouble is often met with, and is annoying, because, with the exception of a ring of corroded surface round the top inside, the pot is perfectly sound. The only advice that can be given at the moment is to try the use of different fluxes, and to limit them to as small a quantity as is permissible; also to remember that a perfectly even flame of the correct quality seems to have a beneficial influence on this inside corrosion. Generally speaking, one finds each particular foundry has a favourite flux of its own; the most usual for brass and copper alloys being pearl-ash, fluor spar, potassium sulphate, salt cake, common salt, nitre, argol, borax, glass, &c. Charcoal is much used—not, of course, as a flux, but as a preventive of oxidation.

LIFE OF CRUCIBLES.

All these causes of failure in pots, with the exception of scaling, apply to coke-heated crucible furnaces no less than to gas-heated ones; and the question arises, after the presentation of such a formidable-looking list, as to what life may be reasonably expected of the pots. Naturally, this varies greatly with the metal being melted, and the usage to which they are subject. Small pots last longer, as a rule, than large ones, and pots in tilting furnaces longer than those in pit furnaces—the life of the latter is shorter on account of their handling by the tongs. To mention definite figures, I know one brass foundry where the average life of coke-fired (60-lb.) crucibles was about 30 to 35 melts—a figure which appears fairly to represent ordinary coke practice. For these people we installed a battery of 60-lb. pit type air-blast crucible furnaces, and now they average 80 to 90 melts per pot. In fact, I have seen pots after they have done 100 to 105, and even 110, melts that appeared good for several more melts, but had lost shape through the continual pressure of the tongs in pouring, and which were discarded solely for this reason. In another works, where our 300-lb. tilters are in use melting brass, this foundry regularly obtains 100 melts per pot; and the firm assure us, in spite of our original scepticism, that they have attained 196 melts per pot. They have a good method—they pay the workmen a bonus on every melt per pot above a certain number. It is only fair to say that in both the above cases high pouring temperatures are not necessary, and results like this could not be obtained with gunmetal and cartridge metal, which have to be poured at much higher temperatures. In the melting of aluminium, on the other hand, a high figure should be obtained. Only a few days ago, in a works where we had installed several 600-lb. tilters, the foundry manager informed us that he was obtaining 150 melts per pot, and was very satisfied with such a result. One of the metals that causes the shortest life of pots is cupro-nickel. This alloy has to be raised to a temperature of approximately 1370° C. before pouring; and as the surface of the metal must be protected by flux, long life can hardly be looked for. In coke-melting, using the 250-lb. size (pit type), the average life is four melts. In a large installation made by us, this size of pot is giving an average of about 14 melts per pot; while with the 60-lb. size an average of from 18 to 19 melts per pot is obtained.

Before leaving the matter of pots, I would say that a pot always seems to give longer life if it can be made to glaze over the outside. Glazing very often occurs without taking special steps to ensure it—in fact, it happens in a gas-furnace when the setting of the burners and conditions generally are correct. But sometimes reagents, such as water-glass and the like, are painted on the outside of the pot before use. The glaze protects the graphite from oxidation. There is a further cause of damage to pots that should be noted—due to careless charging. If two cold ingots, for instance, be wedged together, they will expand as they heat, and often burst the pot or damage it severely.

GAS CRUCIBLE FURNACE LABOUR.

The third factor I mentioned was labour. On this point I can only give you some general facts. Coke-furnaces necessitate the storage and handling of fuel, the disposal of ashes, and the reclamation of metal from them; while gas-furnaces merely require the starting of a blower and the manipulation of two cocks. In the light of what I have already said with regard to the care of linings and crucibles, it will be understood that, to get satisfactory results, reasonable but constant vigilance on the part of the workmen is necessary. The gas-fired crucible is a very satisfactory piece of apparatus when properly used. But just as one would not take an ordinary carter and make him one's motor-lorry driver without training him, so the labour employed on gas-fired crucibles requires some training and experience before it can get the best results from such plant, although the men may have had years of experience of coke-fired pots. I find very often that such men are inclined to make difficulties. By long use the conduct of melting by coke and its precautions have become instinctive to them, and when they turn over to gas they have a different set of conditions to face, and must think before they act. This no doubt is not easy for them; and they are at first inclined to visit on the plant the failures which, as you see, are not due to it. Consider for a moment if these men had been brought up to gas-melting, and had been then required to turn over to coke-melting, how much more irksome they would have found it! After all, the coke-furnace calls for more manual exertion; while the gas-furnace saves this at the expense of a slight further call on the mental functions. To give only one instance, how much hotter work it is removing a crucible from a coke-furnace, still containing the incandescent fuel, than from a gas-furnace where the fuel is turned off while pouring is in progress. However, our experience is that, after a time, the men get to like the gas-furnace better than the coke-furnace.

GAS CONSUMPTION FOR MELTING.

Having now briefly considered some of the points, due attention to which will promote the success of gas melting, we may pass on to consider actual fuel consumptions. As I have already remarked, this is the point to which exclusive attention is generally drawn. It is difficult to select figures which will correctly represent average practice. Some founders require their metal much hotter than others; and to quote figures which could not be substantiated for any particular operation is to court disappointment. It might be argued that one should quote figures for definite pouring temperatures, with the appropriate increases for definite increments of temperature; but the difficulty is that so very few founders know what their pouring temperature is. They know when they have attained it, but not its figure on the scale. Nor is this to be wondered at, seeing that the types of pyrometer for this particular work leave much to be desired.

LABORATORY *v.* FOUNDRY FIGURES.

However, to pass on to the figures. I have the results of the melting tests carried out at many foundries. And let me remark here on the difference between tests carried out at the instance of, and in the works of, the furnace manufacturer, on the one hand, and those made under actual foundry conditions on the other. In the first case, everything is subordinated to the laudable desire to get a low melting figure. The life of linings and crucibles is not in question; there is no possibility of getting information under such conditions. Advantage then is taken, and rightly so, of every circumstance that will help towards the end in view; and the result may be considered as the best possible. In a customer's foundry, on the other hand, very different conditions prevail. In the first place, one may have the inexperience of the workmen to contend against. One may melt a charge, and find it cannot be poured immediately owing to a sufficient number of moulds not being ready. Gas must therefore be used to keep it at a suitable temperature till the moulds are ready, or there may be a practice of knocking-off for meals, irrespective of batches of metal getting ready, and, further—and also militating seriously against good melting figures—the metal may be asked for at very high temperatures, sometimes unnecessarily high, merely because that particular foundry has been used to such heats in the past. Take, for example, gunmetal. The Admiralty mixture is 88 copper, 10 tin, and 2 zinc; and the usual requirement is to specify a breaking load of not less than 14 tons per square inch, with an elongation of at least 7·5 p.ct. The difference between results obtained may be illustrated by reference to the following figures giving the cubic feet of gas per pound of metal melted:

GUNMETAL.

	First Melt.	Second Melt.	Average over Twelve-Hour Shift.
Foundry A	9·03	5·93	5·00 c.ft. of gas.
Foundry B	7·42	3·98	3·37 " " "

These melts were carried out at quite different foundries under the eye of the same observer in each case. The treatment of the metal and pouring temperature were, of course, determined by the foundries concerned; while the other possible variable condition—viz., the calorific value of the gas—was also out of the control of the observer. This latter may account for some of the difference in the melting figures, but in my opinion, and after due consideration of all the facts, not for much of it. The main reason for the difference in the figures quoted was the pouring temperature of the metal.

CAUSES OF DIFFERENCE IN MELTING FIGURES.

Another cause of wide difference in the melting figures for the same metal is the physical state at the commencement. To take gunmetal again—it may be put in the pot in the form of ingots of the alloy; and this will give the lowest possible melting figure. Very often, however, the alloy is prepared from its constituents. In this case, the copper is melted first; being put in the pot as ingots of virgin copper. It is fairly clear that, as the melting point of this metal is higher than that of the alloy, while the zinc and tin, or about 12 p.ct. of the whole, cannot be preheated on account of their low melting points, more gas will be required to make the alloy than to melt it. The more finely-divided the metal is, the more gas it requires to melt it. We usually find ingots are the easiest to melt. After them, heavy scrap like runners. In fact, between the two there is not much difference. Light scrap takes rather more gas; while swarf may need double, or often treble, the gas necessary for ingots. In general practice, apparently, mixed charges are fed indiscriminately; but from our experience we consider it best in gas practice to charge the lightest scrap first, the heavier next, finishing up with the heaviest.

The foregoing remarks refer to any metal or alloy by itself. Very often when making alloys from the virgin metals, a percentage of scrap alloy resulting from a later stage in the manufacturing process is used to make up the full charge. For instance, in making cartridge brass, 30 to 50 p.ct. of scrap comes back from the blanking stage to be remelted. This has a lower melting point than the copper; and by charging some of it before the copper ingots, the latter are assisted to melt by conduction from, and by the solvent action of, the liquid from the scrap of the more easily melted alloy. Without this contact the ingots must first be melted very nearly entirely by radiation from the pot wall, as they only touch the pot at a few points. Many small economies may be made in this and similar ways. It should be borne in mind, however, that judgment and experience are necessary in making use of such "wrinkles." For instance, any small gain of this sort may be more than counterbalanced by loss of zinc if brass scrap is exposed directly to the flame; for zinc is volatile at a very low temperature.

As regards further figures for various alloys and metals, the appended table is interesting; and the results are the more valuable as they are all figures obtained in the foundries of independent firms, and include no purely laboratory tests.

Some Figures Representative of Works Practice.

MELTING.

Operation.	Size of Crucible.	Average C.Ft. Gas per lb. metal.	Average Time per Melt* Gross.	Net.
Melting common brass ingots and scrap for castings, 60/40.	60 lb. pit	2·40	35½	25
Making gunmetal for castings, 88/10/2	100 lb. pit	3·37	48½	39
Making cartridge metal strips, 70/30	300 lb. tilter	3·54	72	50
Making cupro-nickel strip, 80/20.	60 lb. pit	8·50	59	53
Melting aluminium	600 lb. tilter	3·20	49	34
Making 70/30 cartridge metal.	600 lb. tilter	3·00	93	81

* The difference between gross and net melting time represents pouring and charging, and will vary in different foundries according to the rate at which the moulds can be poured.

ANNEALING.

Operation.	Load.	Duration.	C.ft. ton.
Annealing H.S. steel	3½ tons	8 hours	3000
Annealing steel	3½ tons	15½ hours	6000
Annealing cast iron parts packed in filings in boxes	2000 lbs.	3 hours	3360

DEVELOPMENT OF THE GAS CRUCIBLE FURNACE.

I have already given a slight sketch of some of the types of coke-furnaces with which the gas-furnace has to compete. If we look at gas-furnace development for a few minutes, it will not only be interesting from a historical point of view, but will give some idea of how figures have been brought to the present level. The first gas-heated crucible I can call to mind was one in which I used to melt small quantities of copper for laboratory purposes. In this furnace, the burner was so placed that the flame struck the crucible directly—*i.e.*, the horizontal axis of the burner would pass through the vertical axis of the pot and at right angles to it. This type was later superseded by that having the axis of the burner tangential to the circumference of the pot or to the inside of the furnace; and practically every crucible furnace burner for other fuels than coke is now arranged after a similar fashion. An air-blast burner of the ordinary blowpipe type was the burner first used in the tangential position. Later on high-pressure gas began to be experimented with.

In this system the gas is usually compressed to approximately 12 lbs. per square inch; and at that pressure it is capable of injecting the air necessary for its complete combustion into the furnace from the surrounding free air against the back-pressure

of the furnace itself. We had considerable experience at the outset; and as a result we were led to the conclusion that it was not a very satisfactory method. We found it unsatisfactory in respect of gas consumption and of output. In a recent paper dealing with high-pressure gas, foundry results are given over long periods; and these fully confirm our experience. In output, they show for instance, for 60-lb. furnaces, an average time per melt of one hour, and a yearly output of approximately 60 tons per furnace—that is, 2240 melts per annum. In one of our 60-lb. furnaces, we get an average time per melt of 35 to 40 minutes, and approximately 4000 melts per annum, or over 100 tons of metal. For high-pressure gas, the paper referred to shows 5 c.ft. and upwards per pound of metal melted; while for the same metal we find in our furnaces a consumption under foundry conditions of 2 to 3 c.ft. per pound.

The nature of the advance we have made may be summarized in the improvements to burners, and the arrangements for preheating the metal. These are the improvements that show in the melting figures; but there are others which show only during works' practice over long periods—such as the arrangements already referred to for cleaning slag from the furnace; improvements in the quality of the linings to stand the attack of oxidized metal; and the generally increased life of the furnace as well as the crucibles.

The Wright-Brayshaw Burner.

These improvements are due partly to design of the furnace and partly to the Wright-Brayshaw burner. This latter is so designed that it will give as nearly as possible a perfect mixture of gas and air and occasions an intense combustion, if required, by means of which very high temperatures may be obtained. Anyone familiar with gas-furnace work will appreciate this when I say that by its means we are able to melt pure Mond nickel with perfect ease.

Metal Preheating.

Perhaps the most striking advance in the last year or two has been in the construction and use of arrangements for preheating the metal. In ordinary coke practice, this is not done; but we soon formed the view that, with a fuel like coal gas, advantage should be taken of all the heat that could be reclaimed from the products of combustion. For this reason, we introduced a preheater on our pit furnaces (we already used them on our tilting furnaces); and the result is very satisfactory from the point of view of gas consumption.

There are, however, other results that require mention; and I will refer to them shortly. In practice, apart from laboratory tests, the use of an efficient preheater will often reduce the gas consumption by (roughly) one-third. It is necessary, however, to ensure that should some parts of the metal be heated more than others and run at the edges, as often happens, these small amounts of molten metal should be directed into the pot; otherwise they lodge in the preheater or run down the furnace linings with the same result in each case—corrosion of the brickwork.

Recuperation of Gas and Air.

After the preheating of the metal, one would quite naturally turn to the recuperation of the air or gas or both. In small furnaces the advantage of this is not so apparent in practice as calculations might lead one to anticipate. The specific heat of air or coal gas is a very low one, which means that a considerable rise of temperature only accounts for a relatively small quantity of heat. This means that, to be really useful, the preheating must be carried to a high temperature. For instance, one cubic foot of air raised from ordinary temperature to 1000° C. contains roughly speaking (and disregarding any increase of specific heat at high temperatures) 35 B.Th.U., and further occupies roughly speaking, when heated to that temperature, four to five times its original volume. It will be at once apparent that for a given pressure, a jet which starting cold will pass the correct quantity of air, will be inadequate when the temperature is raised by recuperation. The same reasoning applies to the gas. In an ordinary burner then, where the injection of gas by air is relied on for obtaining and maintaining the correct mixture, the conditions of equilibrium are considerably upset if one or other constituent be preheated; and if both be preheated to the same degree, special precautions have to be taken to ensure the requisite volume at all states of the preheating. Another consequence of the low specific heat is that the exposure to an environment at lower temperature of even a few inches of the pipes conveying the preheated gas or air will cool-down the gas or air with loss of practically all the heat that has been imparted to them.

Another consideration is worth mentioning. When iron is exposed to the action of gas or air or products of combustion at high temperatures, it suffers rapid deterioration. As a result of this, advantage cannot be taken of the full temperature to which recuperation might otherwise be carried. In spite of these considerations, we have made many experiments with recuperation on crucible furnaces. One form we tried consisted of a 60-lb. furnace with a chamber built round a considerable length of the gas and air pipes, including the junctions of the latter with the burners themselves. This chamber was heated by the products of combustion coming from the metal preheater which was also a covered-in chamber. We had a very searching test of this furnace in an independent foundry, which already used similar gas-furnaces of our make but without the gas-and-air recuperator. I have the exact gas figures for a week's run under foundry conditions, and a comparative week's figures on one of the furnaces without the recuperator. The results showed there was little to choose between the two types of furnace. This does not prove that recuperation has no value. It shows that, under the particular conditions of this test, the value was not apparent in the melting figures—another of the cases where laboratory figures are not borne out in workshop practice.

Preheater Troubles and their Cure.

I remarked in discussing metal preheating that there was another side of it that I wished to mention. This is of outstanding importance; and it may, in a word, be put down as oxidation. In the great majority of cases crucible furnaces are used for melting or making some alloy or other of copper. Copper is a metal that is easily oxidized. It forms not only the black oxide CuO, with the appearance of which we are all familiar, but also the reddish cuprous oxide Cu_2O; and it has the curious property of forming a well-defined series of alloys with this its own oxide. It is stated that in copper itself unless the amount of Cu_2O present exceeds 2·25 p.ct. (equivalent to 0·25 p.ct. of oxygen) it is not injurious, and in fact copper from which all traces of oxygen have been removed—*i.e.*, overpoled copper—is incapable of being worked. I well remember annealing some copper strips in various materials, one of which was charcoal; and the strips after this charcoal treatment could be broken across by bending once in the fingers. In other words, some small amount of oxygen should be present—say, about 0·06 p.ct.

In coke-melting where preheating is not resorted to, and where often a lid is used on the pot, there is not so much tendency to oxidize the copper as in gas-melting, where the products of combustion are in contact with the metal in the preheater. Consequently, unless care be taken, too much oxide may be formed. In copper melting, this necessitates poling the metal or the addition of cupro-silicon as a deoxidizer before pouring. In making alloys, however, the case is different. In brass-making the zinc itself acts as a deoxidizer; and perhaps the only precaution to be taken is to ensure that particles of zinc oxide be not retained in the cast metal. In bronze or gun-metal rather different conditions prevail. In the usual gun-metal already mentioned, 2 p.ct. of zinc is added to the copper; and this acts as a deoxidizer and softener. But if much oxygen is present, it cannot be effective; for theoretically 2 p.ct. of zinc is only capable of removing about ½ p.ct. of oxygen. Where the zinc does not remove all the oxygen, it means that, when the tin is afterwards added the oxide of this metal, SnO_2 is formed; and it has two deleterious effects. Firstly, the tin oxide is very infusible, and forms a pasty mass even at temperatures so high that nothing can be seen in the furnace by the naked eye; and if the metal be then poured, portions of this oxide are trapped in the castings, rendering them unsound. Secondly, the tin thus used up to make oxide prevents the alloy from being of the correct composition to give the requisite mechanical properties. Thus, gun-metal containing 10 p.ct. of tin consists on cooling of a mixture of two different copper-tin alloys, the first of which is known as alpha copper-tin, and is a solid solution of tin in copper containing up to and not more than 9 p.ct. of tin, and the second of which is called delta copper-tin, and consists probably of a compound Cu_4Sn, containing about 32 p.ct. of tin. The latter compound may be seen in photomicrographs of gun-metal as a lighter-coloured constituent, in between the masses of the yellower alpha copper-tin. If, however, the amount of tin be diminished below 9 p.ct., all the tin goes to form the alpha constituent; and the second or delta constituent cannot be formed, as roughly ½ p.ct. of oxygen in the copper is sufficient to oxidize 2 p.ct. of tin to SnO_2—thus bringing about the conditions mentioned. It will be seen how easily oxidation of the copper during the melting can upset the resulting alloy.

In mentioning these difficulties that occasionally arise, I must say that in other cases of melting the same metals with the same type of furnaces they are not met with, and one is driven to the conclusion that local conditions are responsible, by which I mean the original brand of virgin metal used, flux, gas quality, and manipulation generally. The problems as they confront one are intensely interesting; and I think I have said enough to indicate that to tackle them—as the gas-furnace exponent is bound to do, for any fault is always attributed to the furnace—requires not only a knowledge of gas-furnaces but of metallurgy as well. A case such as I have outlined above was proved to be curable by poling, which is tedious and arduous, or (alternatively) by adding phosphor copper in the correct quantity—the phosphorus, with its well-known avidity for oxygen, removing the latter with formation of the oxide of phosphorus. It must be again noted that the use of such expedients requires judgment—an excess of phosphorus would be as bad as the original fault.

Before leaving this part of the subject, another influence that may alter the mechanical properties of the alloy must be mentioned. I refer to the pouring temperature. I have already stated that Admiralty gun-metal must show a tensile strength of at least 14 tons per square inch, and an elongation of 7·5 p.ct. These figures can be readily obtained; but they may be greatly modified by the casting temperature. For instance, Longmuir

gives the results of three tests from the same batch of gun-metal as follows:

	Pouring Temperature.	Maximum Street.	Elongation.
1	1173° C.	8·4 tons per sq. in.	5·5 p.ct. on 2 in.
2	1069 ,,	14·8 ,, ,,	14·5 ,, ,,
3	965 ,,	11·0 ,, ,,	5·0 ,, ,,

And during our own investigations, we have incidentally confirmed these figures. As the judging of temperature by the eye is somewhat different in gas-furnaces compared with coke-furnaces, it is easy for the inexperienced workman to spoil the metal before he becomes accustomed to the altered appearance.

(To be continued.)

PYROMETRY AND PYROMETERS.

Discussion at the Faraday Society.

A general discussion on pyrometry and pyrometers took place at a meeting of the Faraday Society on Wednesday last. That the matter was more or less exhaustively dealt with may be gathered from the fact that there were nine printed papers presented and discussed, and that nearly four hours were devoted to the meeting. The subject was suggested a few months ago by Sir Robert Hadfield, F.R.S., the President of the Society; but at the last moment he was prevented from attending, and his place as Chairman was taken by Sir RICHARD GLAZEBROOK, F.R.S., Director of the National Physical Laboratory.

The subject, of course, is so vast that we could not hope to attempt to deal with it in anything like complete detail here. Indeed, it was even felt that the meeting itself had not covered the many problems to be solved; and the suggestion was made that a further evening should be devoted to discussing temperatures of a lower order, such as come within the scope of the ordinary hardening shop, when reheating at 750° or so is necessary. In the circumstances, the gas industry being so directly concerned with improvements in measuring high temperatures, having regard to the increasing number of gas-furnaces in use, a few points are given from the discussion which have a general interest to our readers—the meeting, of course, not being concerned with any particular type of furnace.

Only one recognized advocate of gas-furnaces took part in the proceedings. This was Mr. S. N. Brayshaw; and he interposed to call attention to a 60/40 copper-tin alloy which he employed to standardize pyrometers. This alloy was supplied to him something like fifteen years ago by Mr. P. S. Whipple, of the Cambridge Scientific Instrument Company, and had a freezing point of 738°. It was sent to the National Physical Laboratory to be tested, and since then it has been used to a considerable extent. It was sent to the Laboratory a second time after much use; and it was reported that no change in the freezing point had occurred. The method of standardization, which had been found extremely useful in the shops, was by means of a deep graphite crucible which is covered with an asbestos sheet with a hole in the top, into which the pyrometer fits tightly. The crucible is gas fired; and it is found that when the pyrometer reads 738° it remains at this temperature for quite a considerable time. The apparatus is used to standardize pyrometers to one degree. It so happens that commercial steel containing 1·1 carbon and 0·5 tungsten also has the same property; and the freezing point is not moved by any ordinary commercial variation of sulphur, phosphorus, silicon, or manganese. This may be a useful thing to know. Mr. Brayshaw said he had taken thousands of standardizations from this steel.

Another point mentioned by Mr. Brayshaw was that, in working at temperatures over 1500° C. in gas-furnaces, he uses one of the new optical pyrometers of the Cambridge Scientific Instrument Company, and he had found, by the aid of a photograph, that some Glenboig brick lining had dripped down and glazed some of the special refractories that were being tried. The difficulty of using this optical instrument was that the furnace had to be opened to take a reading; and he invited Mr. Whipple to say what should be done to avoid the very large loss of temperature thus occasioned. During the space of less than half a minute, when the plug was taken out, the temperature dropped by 100° C. The furnace was 1-ft. cube, and the opening 3 in. Ought he to have a fire-clay tube or a lagged tube to the instrument?

Mr. Whipple said the question was very difficult to answer. He had always been hammering at furnace makers that they should make their furnace walls thick enough to avoid heavy losses. There always had been great loss of heat through the walls; and although he did not know the particular furnace to which Mr. Brayshaw had alluded, it would probably help if it had good thick walls. He did not see how to avoid some loss of heat when the plug was opened. It might be possible to have a small glass window; but it would have to be glass of a special character.

The discussion generally, which ranged over the whole field of ferrous and non-ferrous metallurgy, may be said to have divided itself into two main portions—viz., the practical application of pyrometry, and the improvement in manufacture of apparatus, in which may perhaps be included certain new apparatus to which attention was called. We will confine our few remaining notes to the second portion. Incidentally, one of the war's little tragedies was mentioned by the Chairman. In 1913, the work of standardizing high temperatures was discussed between the principals of the German National Laboratory (the Reichsanstalt), the National Physical Laboratory, and the Washington Bureau of Standards. At the fifth Conference on Weights and Measures, which was held in Paris on October, 1913, resolutions were passed by which it was to be the work of the various national laboratories to devise practical methods of measurement, with the intention of introducing an international scale of high temperature at any rate up to 1300° C. Representatives of the Reichsanstalt visited the National Physical Laboratory; and after various schemes were discussed, it was arranged that a conference should be held in Berlin in September, 1914, to settle the whole matter. *L'homme propose, et Dieu dispose.*

Coming to the troubles of the user of pyrometers, Dr. A. M'Came, of Glasgow, complained that instruments by the same makers, and intended to be used for the same purpose, were not infrequently found to differ about 20°. Dr. F. Rogers found himself so dissatisfied with both radiation and optical pyrometers that he set to work and devised a thermo-couple, the ends of which are actually immersed in the molten metal, being carried through the roof of the furnace. He had met with some success, although a number of practical details have yet to be worked out. Mr. W. Carter expressed the view that pyrometers are sold too cheaply, and for this reason it was difficult to get the makers to give much advice as to their use. He confessed to having a pyrometer which he did not know how to use, and, consequently, had not paid for, pending a visit from the representative of the makers. He went so far as to express the doubt as to whether the makers themselves were sufficiently acquainted with the use of the instruments. If they were, they would not make them with so many fiddling little screws, which might be all right for the laboratory, but were hopelessly out of place in a dirty hardening shop. Again, the conditions in the shops were very often such that it was difficult to read the scales; and whereas the men should be working to an accuracy of 1°, they were frequently guessing at 10°.

Dr. Harker, who was formerly first assistant at the National Physical Laboratory and undertook the first investigation on high-temperature measurements, resented the apparent slur cast upon manufacturers in these reflections. Manufacturers in this country had been making great improvements. There were many things militating against them which the ordinary user did not appreciate. Mr. Whipple, speaking for the manufacturers, said they were very often up against a difficult problem. It was a difficult matter to suit all tastes, and some of the stories he could tell of the treatment of pyrometers would probably not be believed. He had come to the conclusion that 90 p.ct. of the pyrometers that were rendered useless were not burned-out, but were broken mechanically. This arose because they were placed in such positions that the workmen could not help knocking them off. As to glass, this now came from America, whereas before the war it came from Germany. It was, however, satisfactory to know that there was some chance of getting monochromatic glass in this country. The makers were taking advantage of all the experience of users, and were hoping to turn out better instruments in consequence.

There was an interesting exhibition of apparatus during the meeting.

Ripon Gas-Works Results.

Tangible proof, in the shape of a substantial increase in salary, has been accorded to Mr. J. Demain (the Engineer and Manager) of the satisfaction of the Ripon Corporation with his administration of the undertaking, the position of which has much improved in the short time he has been in charge. During the six months ended Sept. 30, the make of gas was 23,179,000 c.ft., or at the rate of 12,660 c.ft. per ton of coal carbonized. After considering the circumstances, the Gas Committee decided to recommend the Council to increase Mr. Demain's salary from £200 to £250 per annum as from Aug. 12 last, at which date he had been with the Corporation one year. In the past twelve months, a profit of over £900 has taken the place of a deficit of £500. Complimentary remarks were made regarding the work of the Manager; one member saying that Mr. Demain had had to labour under a great many difficulties, and the results he had brought about did him very great credit.

Llandrindod Wells Gas Company.—Of the four men permanently or semi-permanently employed by the Company, three have had to be released for service, and substitutes found for them. Of these three men, two have been killed—namely, E. Hurst and A. Lloyd, the former after only a few months' service, and the latter after having been twice recommended for the D.C.M. The third one—T. Jones—has been seriously wounded.

Gas Charges Increased at Rochdale.—The increase of 2s. 6d. per ton authorized in the price of coal as from Sept. 17 last has necessitated a further revision of the price of gas at Rochdale. At the beginning of the month named, an increase of 4d. per 1000 c.ft. was sanctioned; but when, later on, there came the rise in the price of coal and further wages demands from the workmen, there was no alternative but to reconsider the matter. As a result, another increase of 4d. per 1000 c.ft. has been agreed to, which it is calculated will about meet the extra expenditure, if further contingencies do not arise.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Something from Nothing—Steaming Effects.

SIR,—Attempts to produce something from nothing are about as profitable a line of effort as that of many dreamers who have worked at getting "perpetual motion."

On considering the results obtained by steaming continuous vertical retort charges as set forth in the important and interesting papers recently presented to the gas industry by Mr. Blundell at Manchester, and Mr. West to the Southern Association, the first impression is likely to be, as it was in my own case, that far too great an increased volume is claimed as an equivalent for the reduced weight of coke produced and made for sale.

I think I have now got a grip of the explanation; and I believe it to be worth the attention of the gas industry.

The action of steaming is not only to split up water; but the steam, in the first place and the water gas after it is formed, purge the coke of volatile matter held in the pores and which, in the ordinary way, would be discharged with the coke, and sold by weight.

To sell gas by weight at present rates is both unprofitable and wasteful. To disassociate volatile matter from the coke, and sell it by volume, is a right use of valuable matter, and will be profitable to those undertakings fortunate enough to have the form of retorting plant which will allow of this practice.

In addition to purging the coke, the steam and water gas may perform other important functions of a protective character. One can understand that the newly formed molecules of marsh gas, other hydrocarbons and ammonia, are protected in this way from the effect of the high temperatures necessary to produce the large yields of pure coal gas quoted as made when the process of steaming was not in use.

The absence of this protective action, when high temperatures are used with horizontal retorts, always results in a reduced yield of oils and ammonia, an increased decomposition of hydrocarbons with the formation of excessive quantities of sulphur compounds, naphthalene, and free carbon. The latter causes stopped ascension-pipes and mains, and depreciates the value of the tar.

The light distillates from liquid hydrocarbons obtained from coal carbonized in continuously operated vertical retorts, may not be suitable for nitrating, when high explosives, or certain bases for the manufacture of dyes, are required; but it may be safely assumed that, in the near future, the raw material for these substances will be produced, in sufficient quantity, from coke-oven tars; and this will set free, for the important purpose of driving internal combustion engines, the large yield of mixed paraffin and aromatic spirit derived from vertical retort carbonization. The heavier oils, of which there is a good yield, will also serve an important national purpose.

Altogether, the total value of products yielded by this high temperature system of carbonizing, accompanied by judicious steaming, must be high, and will satisfy the shrewd business instincts of those responsible for the conduct and direction of large gas undertakings. The coke may not be the free-burning material sought by the advocates of low-temperature carbonization; but these gentlemen have yet to show that they can carry on the process they advocate without incurring heavy losses.

It is undoubtedly important that the wasteful use of raw coal, both for industrial and domestic purposes, shall be rapidly reduced, and that all recoverable products from coal used shall be conserved. But does not the way lie in the direction of increased use of gaseous fuel and the provision of improved fire grates for burning good hard grey coke? Has it ever occurred to our fuel reformers that air under pressure for the active burning of coke is supplied to industrial fire grates, and that the same principle applied to domestic grates might overcome their objection to this fuel?

In conclusion, it may be said that, while the quest to get something from nothing is usually unsuccessful, it is still possible to get a great deal of value from that which is often lost, or wasted, when the right method is adopted.

THOS. GLOVER.

Norwich, Nov. 10, 1917.

Steaming in Vertical Retorts.

SIR,—I am pleased to read Mr. G. W. Tooley's letter published in last week's issue, as it gives me an opportunity of correcting a reporter's or printer's error in connection with my reply to the discussion on the above-mentioned paper.

The passage which Mr. Tooley quotes should have read as follows: "They had two beds going of sixteen retorts, and the average make of gas for the four days, per day, was 628,000 c.ft.; the coal carbonized per day was 40 tons; the make per ton was 15,680 c.ft.; the make per retort was 39,250 c.ft.; and the gross calorific value was 512 B.Th.U." The error appears to consist in the use of the word "bed" instead of "day."

With this explanation I would point out to Mr. Tooley that the output per setting of eight retorts per day with steaming is 314,000 c.ft., which is a considerable increase on what it is possible to obtain without steaming.

In the discussion on my paper at Manchester, the weights of the products obtained from a ton of coal were criticized. The following statement proves the accuracy of the figures, as stated in the paper:

WEIGHT BALANCE SHEET.

Total weight of gas obtained—viz., 15,489 c.ft. of sp. gr. (calculated from analysis) of ·44

$$= 15{,}489 \times 7{\cdot}66 \times 0{\cdot}44 = 520 \text{ lbs.}$$

All of this gas has, however, not come from the 2240 lbs. of coal used, but part has come from the added steam, and part from nitrogen derived from the air and furnace gases.

As 25 lbs. of carbon is estimated to have been converted into water gas (3·1 lbs. to CO_2 and 22 lbs. to CO) the weight of steam used to convert this carbon into CO_2, CO, and H is 42 lbs., which must be deducted from the above 520 lbs.

The gas contains 8 p.ct. of nitrogen, not more than 1 p.ct. coming from the coal itself, and the remaining 7 p.ct. is drawn from an outside source. As 7 p.ct. of 15,489 is 1084 c.ft., the weight of which is $10{\cdot}84 \times 7{\cdot}44 = 81$ lbs., this must also be deducted from the 520 lbs. The net weight of gas actually obtained from the coal is, therefore, $520 - 42 - 81 = 397$ lbs.

We have then

Net weight of gas from 1 ton of coal	397 lbs.
Weight of tar, 16·61 gallons of 10·8 gall. per ton	179 ,,
Coke 13·36 cwt.	1496 ,,
	2072

This leaves $2240 - 2072 = 168$ lbs. for virgin liquor, equal to a yield of 16·8 gallons of virgin liquor per ton, which is a very probable figure from the coals used.

J. E. BLUNDELL.

Macclesfield, Nov. 9, 1917.

Sale of Gas by Second Parties.

SIR,—"Legal aspect" is a sure pitfall in commercial life; and an expression of lay opinion in your last issue (if correctly reported) should not pass without question. If a gas undertaking has not the exclusive right to sell gas what might its rights be?

According to "Michael and Will" statutory gas companies acquire by implication a regulated monopoly in the supply of gas as well as power to open streets and lay pipes.

The right to a supply of gas is restricted by section 11 of the Gas-Works Clauses Act, 1871, to owners and occupiers of any certain premises in the area of supply; while section 18 of the 1847 Act makes it an offence for any person to supply any other person with any part of the gas supplied to him.

It would be unfortunate if, through misapprehension, difficulties are not avoided, and they can be by agreement or contract.

Nov. 10, 1917. OIKONOMIA.

Meter-Rents.

SIR,—Meter-rent or hire has been practically abolished by all gas undertakings; but in these strenuous times I am surprised that in all the discussions on the hardships caused to the gas industry generally and to sliding-scale companies particularly by the high costs of fuel, wages, &c., this question of meters has not been mentioned. No doubt in normal times to go back to a charge for meter-hire would be a retrograde step. But these are not normal times; and these charges might well be reverted to as a temporary measure, and one which would prove of considerable and immediate financial relief to all gas undertakings, and one which would not in any way affect the sliding-scale.

In present-day practice, I find that the cost of meters—for interest, depreciation, and repairs, taken at 10 p.ct. on the cost of the meter—may and does amount to as high as 2s. per 1000 c.ft. in extreme cases, down to from 6d. to 1s. in many cases, and on an average to somewhere about 3d. Now 3d. per 1000 c.ft. would make all the difference in the world to most undertakings at the present time. Its collection would be easy, it would be at once available; and it would fall to a large extent on the consumer who, at the present time, is by a long way in the best position to pay a little more, and who is at the same time the worst customer.

I may say that I have suggested to my Board that a minimum annual consumption of gas should be fixed for each size of meter; and if the actual consumption through the meter does not reach the minimum, then a charge equal to (say) 10 p.ct. on the cost of the meter should be made in addition to the price of the gas. There are also many instances where the lighting of premises is electric, but where a gas-meter is retained merely as a stand-by. Why should such a meter not be charged for?

Of course if the Board of Trade accede to the proposals laid before them, or give some adequate relief in other form, then this question is not so acute. But, all the same, it is worthy of discussion in a general way; and if you can open your columns for such a discussion, the opinion of some of the "Head Yins" in the gas profession, for or against, would be well worth having.

Nov. 5, 1917. "FAIRPLAY ALL ROUND."

LEGAL INTELLIGENCE.

PROSECUTION OF GAS COMPANY AND OFFICIALS.

Failing to Furnish Particulars to the Minister of Munitions.

Last Thursday, before Mr. FRANCIS, at the Westminster Police Court, summonses were heard at the instance of the Director of Public Prosecutions against the Longridge (Lancs.) Gas Company, the Secretary-Manager (Mr. James Lee), and the Directors (Messrs. Robert Eccles, James Fisher, William H. Knowles, John Burton, and George Dagger) for failing to comply with the requirements of the Minister of Munitions as to furnishing particulars in pursuance of an Order made to coal-tar and coke-oven bye-products.

Mr. ROOME (instructed by Mr. W. Lewis) appeared for the prosecution, at the instance of the Public Prosecutor by direction of the Ministry of Munitions.

Defendants severally pleaded guilty—Lee with the reservation that he only received one letter from the Ministry of Munitions.

Mr. ROOME said the position was that, under Regulation 15c of the Defence of the Realm Act, the Admiralty, Army Council, or Minister of Munitions might require persons engaged in specified

businesses to give particulars thereof; and Orders were made by the Minister of Munitions relating to coal-tar and coke-oven bye-products, dated Oct. 31 last year. A circular-letter was, on July 12, addressed to the manager of every gas undertaking throughout Great Britain, asking for replies to four questions regarding production, &c., of tar. The letter and form were sent to Lee; but no reply was received. Therefore, on July 30 another letter was sent from the Ministry of Munitions (Explosives Department) drawing attention to the fact that no replies to the questions had yet been received, and pointing out that failure to furnish the information within the time allowed was an offence against the regulations rendering offenders liable on conviction to severe penalties. "While," it was added, "this Department would be most reluctant to have to resort to drastic measures, the urgent national importance of obtaining these returns necessitates its exercising its full powers to ensure securing them. You are accordingly requested to give the matter your immediate attention, and furnish replies to the questions addressed to you within three days from this date at latest." Surprising as it might seem, there was no reply to this from the Company or from any official. The letter was absolutely ignored, as had been the previous one. So a third letter was sent, on Aug. 10, addressed to the Secretary of the Company, again asking for the completion of the form of questions and its return with the least possible delay. Again this letter was ignored; and he might say that, out of close on 1500 gas undertakings in Great Britain, in all but five cases prompt replies were sent to the important questions. Out of the five undertakings which failed to comply, one concern was utterly negligible—doing no business—and in the other instances satisfactory explanations were afforded. The defendants remained the one and only Company who had ignored the authorities and treated with studied discourtesy the requirements of this Government Department. This being so, the Ministry of Munitions felt it their duty to show that they would not permit their Orders to be trifled with; and such penalties were asked for as the seriousness of the default would warrant.

Evidence having been given with regard to the Order and letters,

Lee denied that he received the letters other than the one dated Aug. 10. There must be some misunderstanding.

The MAGISTRATE: A very serious misunderstanding. It seems to be a case of expressly ignoring the authorities.

Several of the Directors remarked that they knew nothing about the matter until they received their summonses.

Lee, giving evidence, said that he was the Secretary of the Company, whose capital was only £5650. As to the letters, he only received the one in August.

Mr. ROOME (cross-examining): You have heard the detective who visited the works say that you received all the letters—that you admitted it?

Witness: That is a misunderstanding on his part. I feel sure I did not say that, and I say he was mistaken.

And you said you had sent the information. When do you say you sent that?—I can't give you the exact date. It was some time in August. I asked for forms to be sent me; and the information was put on an official form which was forwarded to me without any letter after I had sent a telegram: "Please send forms." I did not keep any copy of the return. I have endeavoured to trace the telegram, which was after Aug. 12. There was no reference to any of these matters recorded in the minutes of the proceedings of the Company.

In further cross-examination, witness said one of his daughters worked out the information as to the sales of tar for 1916. He produced the document—it was simply memoranda. This document was drawn up about six or eight weeks ago.

The MAGISTRATE: Long after these complaints of neglect.

Mr. ROOME: Yes; and there is nothing to show that it was not prepared until after the summonses were served.

Mr. *A. E. Plant* said no telegram was ever received at the office of the Ministry of Munitions; and no form was sent without a letter.

The MAGISTRATE said the defendant Lee appeared to have misled the Directors; but they could not be absolved on this account. They had very evidently been "let down" by the carelessness and negligence of Lee, who would be fined £20. The Company itself would also be fined £20, and 10 guineas costs, and each of the Directors, who, of course, were responsible, would be fined £5.

Theft from the East Greenwich Gas-Works.

At the Greenwich Police Court, on Saturday, before Mr. Waddy, William Sageman, a locomotive driver, was charged with stealing and receiving 25 lbs. of brass tubing, value 25s., the property of his employers, the South Metropolitan Gas Company. The prisoner was stopped by detectives, and told them that a canvas bag which he carried contained firewood; but when it was opened, the contents were found to be some lengths of brass tubing. These the prisoner said he had picked up "along the road;" but when told he would be detained while inquiries were made, he said he got it from the locomotive works of the Gas Company. The prisoner, who pleaded guilty, had been ten months in the Company's employ, at an average wage of £4 per week, and was a man of good character. The Magistrate said it was a calamity that a man in the prisoner's position should have chosen to forfeit his good character. He must go to prison for fourteen days, with hard labour.

Economy Needed at Reading.—Owing to the large increase in the consumption and the difficulty in obtaining materials for the manufacture and distribution of gas, the Reading Gas Company are requesting their customers—and particularly those who have gas-fires and gas-cookers—to do all possible to economize in the use of gas.

WAR WORK

Has had first place with us since 1914.

We appreciate, however, our customers' needs for "D.S.O." Fires and Gas Steam Radiators. In thanking our many clients for their orders, we would respectfully beg their indulgence if their exact requirements cannot be met at once, and we suggest to save delay that alternate sizes and finishes be accepted where possible.

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WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.

SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 83, Old Market Street, BRISTOL; 18, Severn Street, Deansgate, MANCHESTER; 97, Millfield, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF COMMONS.

Coal Gas for Motor-Cars.

Mr. BILLING asked whether the Government wished to encourage or to discourage the employment of coal gas for the propulsion of motor-cars.

Mr. WARDLE, replying for the Prime Minister, said the Government saw no objection to the use of coal gas for motor-cars so long as a scarcity of gas for other purposes was not caused thereby.

Mr. BILLING asked whether facilities would be given to people to employ coal gas so long as there was no scarcity, in view of the fact that they were allowing it to escape at certain munition factories because they did not know what to do with it.

Mr. WARDLE said that, so far as he was aware, these facilities were already given.

Mr. BILLING asked whether a man should be allowed to carry coal gas under compression on his motor-car.

Mr. WARDLE said that if application was made in the ordinary way he did not think he would have any difficulty in obtaining facilities for getting coal gas.

South Staffordshire Mond Gas (No. 2) Bill.

On Thursday, the Bill promoted by the South Staffordshire Mond Gas (Power and Heating) Company came before the Chairman of Committees of the House of Lords (Lord Kintore), as an Unopposed Bill. It was explained that the sole object of the measure was to enable the Company to give security to the Minister of Munitions for advances to be made by him to enable the Company to extend their works so as to supply certain munition factories in the neighbourhood. Amendments indicated by his Lordship at an earlier stage had been introduced into the Bill, which, as amended, was ordered to be reported for third reading.

Price Raised at Carnarvon.—The Carnarvon Corporation have decided, following upon the advance in the price of coal, to raise the charge for gas 3d. per 1000 c.ft. The discount of 1d. off every 1s. in the case of slot-meters is to be discontinued.

Price of Gas at Wilton.—Recommendations of the Gas Committee agreed to by the Wilton Town Council included the raising of the price of gas from 4s. 6d. to 5s. per 1000 c.ft., to take effect on the Christmas quarter gas-rentals. Further, that the 1s. meter-rent which was imposed on the slot-consumers in lieu of the last increase should be discontinued, and that these consumers should pay at the rate of 1s. extra per 1000 c.ft. on the amount registered.

MISCELLANEOUS NEWS.

SOUTHPORT CORPORATION GAS DEPARTMENT.

Annual Report.

The annual report of the Southport Corporation Gas Department for the year ended March 31 was submitted for confirmation at the annual meeting of the Town Council on Friday, and passed without comment.

Mr. John Bond, the Manager, reported that there was a decrease in the consumption of gas amounting to 69,963,600 c.ft., as compared with last year's figures. The prepayment system amounted to 18·37 p.ct. of the whole sale, and showed an increase of 0·66 p.ct. on last year's figures. The average price received for all gas was 2s. 8·12d. per 1000 c.ft. The gross profit for the year amounted to £13,890; and after paying £11,717 towards the interest and sinking fund, and contributing £6000 in relief of the rates, there is a debit balance of £3827 to be carried forward. The capital account (total amount expended) stands at £307,080, and the gas-works debt, after deducting payments through sinking fund, £163,332. The gas-making material used was as follows: Coal, 44,181 tons; oil, 772 tons; coke, 2460 tons. During the year, coal advanced in price; and the Committee had to pay 7s. 2d. per ton over 1913-14 prices. The total increase amounted to £15,837. The advance in the price of coal was greater than that fixed by Parliament under the Price of Coal Limitation Act, and was accounted for by the Committee being forced to purchase through and through and screened coal instead of slack. Unfortunately the quality of this coal was not much better than that of the slack previously purchased, as the coal contained an excessive amount of inert matter. The total increase in the cost of oil used for the manufacture of carburetted water gas amounted to £3228, and the increase in wages, *plus* the war bonus paid to various workmen, amounted to £550. Therefore, the total increase in the cost of material used in carbonization and labour over pre-war rates amounted in all to £19,615. Mr. Bond remarked that all other materials used in connection with gas-works practice had increased in price to an enormous extent. With regard to residual products, difficulties arose with respect to the disposal of tar; and the Committee were unable to sell this material. Fortunately the Gas Department had erected a new tar dehydrating plant; and this enabled the Gas Committee to distil the tar made throughout the year. The whole of the distillates from this plant were readily disposed of or used on the gas-works; but the residual pitch had to be stocked, and extra expense was involved in handling this material. Prices for the sale of sulphate of ammonia had from time to time been fixed by the Government, and the export of this material stopped. Owing to the shortage of vitriol, prices were advanced by

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The "DAVIS" Regenerative Muffle Furnace

THIS Furnace is constructed on the regenerative principle, the secondary air, on its way to the combustion chamber, being caused to take up a considerable proportion of the heat that would otherwise be lost by radiation, &c.

Firing is effected by means of the Davis Patent Self-Intensifying Burner, the exceptional power of which, combined with the regenerative action referred to, ensures a muffle temperature as high as 1150° C. without air pressure, and with an efficiency rarely equalled.

MADE IN 3 STANDARD SIZES:

No.	Size Over All			Size of Muffle Chamber			No. of Burners	Gas Supply	No. of Flues	Size of Flues	PRICE
	H'ght	Width	Depth	H'ght	Width	Depth					
	in.	in.	in.	in.	in.	in.		in.		in.	
D.R.M. **1** ...	31	15	20⅜	3⅜	5½	9¾	1	¼	1	3	**£7 17 6**
D.R.M. **2** ...	37½	19¼	24⅜	4½	7	11½	2	¾	2	3	**11 5 0**
D.R.M. **3** ...	37¼	21	27	5	8	14½	3	1	2	3	**13 10 0**

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THE DAVIS FURNACE COMPANY

(Proprietors: The Davis Gas Stove Co., Ltd.),

DIAMOND FOUNDRY, LUTON, BEDS.

the manufacturers on three occasions during the year. The quality of the acid had depreciated, and the department had been put to expense in extracting large quantities of arsenic from the vitriol during the process of the manufacture of sulphate of ammonia. Many experiments had been made with a view of utilizing the arsenical residue; but so far the department had been unable to treat this material commercially. The Ministry of Munitions requested the Gas Committee to manufacture liquid ammonia in place of sulphate of ammonia. This the Committee consented to do; and a plant was purchased at a cost of £1800—the Government allowing a grant. The plant was now successfully dealing with the whole of the ammoniacal liquor made at the gas-works, and also a quantity of liquor which the department obtain from other sources. The Gas Committee had been successful in extracting products required by the Government for the manufacture of high explosives; and a number of experiments had been made on a working scale with the object of assisting the Ministry of Munitions in various ways. The "Southport" debenzolizing plant was erected for the recovery of benzol and toluol, and had worked satisfactorily. This class of plant had been adopted by a large number of gas undertakings in the country. The maximum and minimum makes of gas during twenty-four hours were 2,278,000 c.ft. and 917,000 c.ft. respectively. Having regard to the enormous increases in all materials used in, and other costs of, the manufacture and distribution of gas, Mr. Bond expressed the opinion that it would be a wise policy for the Gas Committee to increase the price of gas at an early date.

NEATH GAS STOKERS' STRIKE.

[From a Local Correspondent.]

Worthy of record is the interesting story connected with the Neath Corporation gas stokers' strike, which is now happily settled. When the men threw down tools, and left the illumination of the town in doubt, the Manager (Mr. W. C. Jackson) called his clerical staff together, placed the position before them, and called for volunteers to "keep the gas-jets burning."

The response was unanimous; and within an hour the clerks forsook their desks and books, donned overalls, and took up positions before the blazing furnaces. All through the night they worked heroically to keep up the gas supply. The Manager, financial officer, clerks, and collectors, though aching in every joint, and almost overcome by the heat, kept manfully at their posts; and when dawn broke, and success had been attained, they pledged themselves to carry on day and night to save the town from darkness. For three days and four nights they knew not sleep. The light failed not; and no great inconvenience was felt at the local munition works. Then the stokers settled their grievance, and returned to work.

Such loyalty is worthy of recording; and the townspeople generally owe a debt of gratitude to the Manager and his clerical staff for saving the situation. The foresight of the Manager last spring, when he installed the carburetted water-gas plant, has been more than justified. It has helped to keep the supply of gas in the town and district normal.

GAS FOR MOTOR VEHICLES.

Motor drivers can learn everything it is necessary to know in connection with local arrangements for filling gas-containers on motor vehicles, by perusal of a circular prepared by Mr. William Higgs, the Engineer and Manager of the Basingstoke Gas Company. The filling station is at the gas-works in Basing Road; and the particulars and terms are set out as below:

PARTICULARS AND TERMS.

Size of connections	2 in. standard gas thread.
Pressure of gas	3 in. water pressure.
Charge	6d. per 100 c.ft. or part of 100 c.ft.
Hours	7 a.m. to 5 p.m. Saturdays, 7 a.m. to 1 p.m.

Extras: Attendance Sundays, or after hours as above, 1s. per filling. Any extra fitting required to containers to be charged for accordingly.

The position of the filling station is within a hundred yards of the three main roads—namely, London to Southampton, London to Salisbury, and Southampton to Reading.

The following gas-works are within twenty miles radius of Basingstoke: Aldershot, Alresford, Alton, Andover, Blackwater, Farnham, Newbury, Reading, Whitchurch, Winchester, Wokingham.

The Highways Committee of the Wandsworth Borough Council have considered a letter from the Wandsworth, Wimbledon, and Epsom District Gas Company, applying for permission to swing a swivel-pipe, about 2½ in. diameter, over the footpath in Warple Way, at its junction with Fairfield Street, for the purpose of filling gas-containers of motor vehicles. The Committee have decided to offer no objection to the proposal, subject to the pipe remaining in the position proposed only during the pleasure of the Local Authority, and to it being kept swung back over the Company's premises when not in use.

The Highways Committee reported to the Maidstone Town Council that they had received an application from the Maidstone Gas Company for permission to fix two standpipes and a meter for the purpose of supplying gas to motor buses for traction purposes. The Committee recommended that such permission be granted, subject to a month's notice on either side, to the payment of a nominal rent of 21s. per annum, and an agreement being entered into at the expense of the Company.

The Sheffield Corporation have decided to run their motor lorries on coal gas; but the City Surveyor reports that there is difficulty in ob-

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"IRONCLAD" Circulator

is being extensively adopted in Factories, Workshops, &c. Can be connected up in batteries to supply any number of taps. Constructed throughout of Iron, there is practically no maintenance required.

Illustration shows three "Ironclads" providing hot water to 13 taps in Canteen Scullery. *They are equally suitable for supplying Hot Water required for Industrial processes,*

We offer the services of our Water-Heating Expert for any propositions.

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WARRINGTON and LONDON.

taining a proper supply of gas for the purpose. However, it is hoped to be able to make effective arrangements concerning additional labour for the Sheffield Gas Company.

The Gas Committee of the Malvern Urban District Council have decided that, in addition to the facilities at the works, gas filling-stations shall be provided on the main roads in Great Malvern, Malvern Links, Malvern Wells, and West Malvern. The price for gas is to be 6d. per 100 c.ft., or part thereof, *plus* 6d. per charge for attendance.

The Bakewell (Derbyshire) Urban District Council have refused the offer of a Sheffield firm to purchase coal gas for motors; this course being adopted owing to the shortage of coal and labour. As coal could not be guaranteed at present, it was resolved to restrict as much as possible the public supply.

In connection with the appointment by the Belfast Corporation of an Economy Committee to inquire into municipal expenditure and questions of cost and overlapping, it is stated, in view of the possible shortage of labour and of the scarcity of horses, the practicability of introducing gas-propelled motor vehicles for scavenging and refuse removal will very likely be investigated.

To permit of housing a lorry in a low building, and yet provide for the carrying of bulky loads, an arrangement has been adopted by a Keighley firm for raising and lowering the tray and container. The movement from one position to the other is accomplished in a simple manner; the rubber supply pipe adapting itself to the movement of the tray.

A London firm are drawing attention through the Press to the fact that they have a number of steel cylinder gas-containers which they can supply, and which they state are eminently suitable for use on motor traction vehicles.

It is stated that the Portsea Island Gas Light Company, who supply Portsmouth and the surrounding district, are quite unable to entertain any scheme for the supply of gas for motor vehicles.

Keighley War Bonus.—The Keighley War Wages Committee recommend an increase equal to 15s. per week on pre-war rates of pay of all full-time male employees of the Corporation over 21 years of age, with a few specific exceptions, to be regarded as a war bonus, and to be in substitution of any bonus previously operating. The bonus is to continue for three months after the end of the war.

Dewsbury Gas Accounts.—The abstract of accounts of the Dewsbury municipal undertakings, presented last week, shows sales of gas during the past year amounting to £32,682, including £23,851 from ordinary consumers and £8638 from prepayment meters. There was a revenue of £14,600 from sale of residuals. The gross profit on the gas undertaking was stated to be £10,458; but sinking fund and interest on loans claimed £9837. The result of the year's working, however, was considered satisfactory under all circumstances; and after transferring £500 to the relief of the rates, the debit balance of 1915-16 was reduced from £2110 to £1990.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Nov.* 12.

Shipments of pitch under export contracts continue to be made regularly. Inquiries are still being received, and the tone of the market is firm. The supplies of solvent naphtha available for near delivery are extremely small, and the previous week's quotation of 4s. net per gallon is well maintained. Anthracene, 40/50 p.ct., is worth 6d. net per unit, packages free. Other products are controlled by the Government, and there are no changes to record with regard to them.

Sulphate of ammonia shows increased liveliness, and considerable orders are being placed for Home agriculture on the basis of the official prices.

Tar Products in the Provinces.

Nov. 12.

There is nothing fresh to report concerning the markets for tar products.

The average values for gas-works products during the week were: Gas-works coal tar, 27s. to 31s. Pitch, East Coast, 20s. to 25s. per ton; West Coast—Manchester 18s. 6d. to 19s. 6d., Liverpool 18s. 6d. to 19s. 6d., Clyde 18s. 6d. to 19s. 6d. nominal. Benzol 90 p.ct., North, 10½d. to 11½d.; 50-90 p.ct., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 3d. Coal tar crude naphtha, in bulk, North, 7¾d. to 8¼d. Solvent naphtha, naked, North, 3s. 1d. to 3s. 3d. Heavy naphtha, North, 1s. 8d. to 1s. 10d. Creosote, in bulk, North 3¾d. to 4¼d. Heavy oils, in bulk, North 4¼d. to 4½d. Carbolic acid, 60 p.ct., East and West Coasts, 3s. 4d. naked. Naphthalene salts, 80s. to 85s., bags included. Anthracene, "A" quality, 3d. per unit; "B" quality, 1½d. to 2d.

FROM A MARKET CORRESPONDENT.

Tar Products.

Licences are now required for nearly all the leading products; and this is bringing about the usual delays and consequent irritation. It says much for the patriotism of the trade that, in spite of the continually increasing cost of raw materials and labour, the recent change in fuel supplies, and the never-ending stream of contradictory orders, manufacturers have not only maintained their outputs of bye-products, but have increased them. Further, they have disposed of their outputs, in most cases, at very little better than pre-war prices, and in many instances, after heavy capital outlay at Government request, at a loss. It is certainly surprising that an industry which received no official encouragement or support in peace time should be so handicapped now that its products are recognized to be of such supreme

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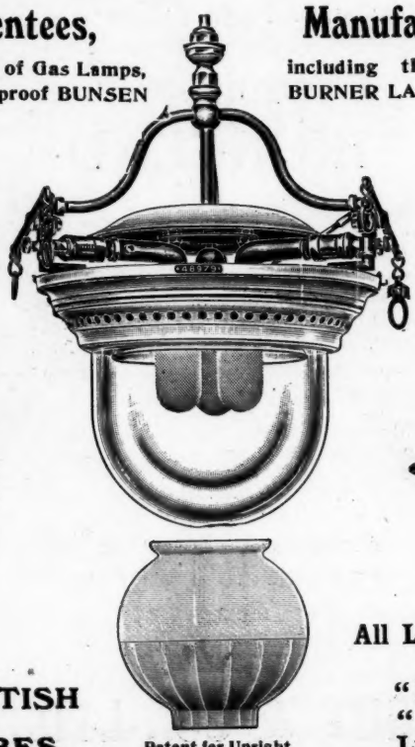

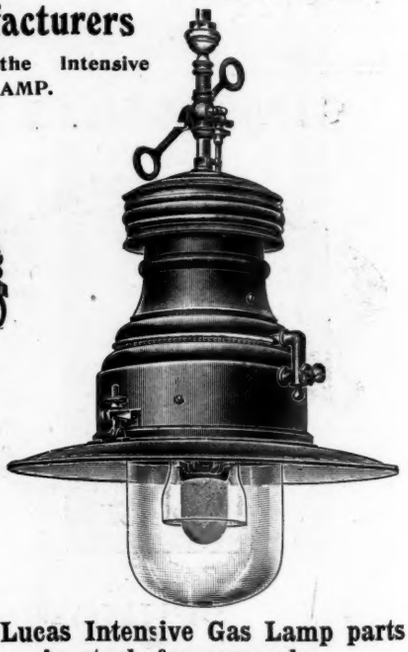

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Patent for Upright and Inverted.

All Lucas Intensive Gas Lamp parts in stock for renewals.
"K" Inverted Burners, &c.
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national importance; and manufacturers are naturally anxious as to what treatment they may look for after the war when outside competition is renewed. The restriction on business, following the order relating to tar oils, has given some opportunity for a survey of the past and the future; and the above remarks cover briefly the lines of argument followed by manufacturers. Very little change is to be noted on the week. London pitch remains at 48s. per ton; but it is probably too soon for the arrangements by which pitch may be mixed with fuel oil to have had any noticeable effect upon provincial quotations. One would imagine, however, that such arrangements would lead to market improvement by reason of the reduction in accumulated stocks that will be brought about; and this should lead to better prices. Meanwhile, a small export trade is being maintained; and while the prospect of its continuance remains, holders are encouraged to refuse low offers, with the result that provincial quotations range from 22s. to 25s. Solvent naphtha remains firm at late rates, with rather more inquiries for forward delivery. Heavy naphtha has experienced good demand, and is slightly dearer at 2s. 3d. per gallon. Aniline oil is dull. Naphthalenes are unchanged at late rates. Cresylic acid is in fair request; but creosote is uncertain. The official limit for the latter is now fixed at 72s., with an extra ⅜d. for works close to ports of shipment.

The range of quotations is as follows:

Aniline Oil (pure): 1s. 2d. per lb.

Benzol: 90% London, 1s. 0¼d., North 10¼d. to 11¼d.; 50% North 1s. 4d. to 1s. 5d. naked per gallon.

Carbolic Acid: 60% East and West Coast 3s. 6d. per gallon; crystals 40%, 1s. 3d. per lb.

Crude Tar: London 28s. to 32s., Midlands 25s. to 26s.; North 26s. per ton, *ex* works.

Pitch: London 48s. f.o.b.; East Coast, 22s. to 25s. f.o.b.; West Coast—Liverpool 21s. 6d. to 22s. 6d.; Manchester 22s. to 23s. f.a.s., Clyde 22s. 6d. per ton.

Solvent Naphtha: Naked London 90-190% 2s. to 2s. 3d.; North 2s. per gallon; 90-160% naked London 3s. 6d. to 3s. 9d.; North 3s. 3d. to 3s. 6d. per gallon.

Crude Naphtha: Naked 30% 8¼d. to 8½d.; North 6¼d. to 6½d.

Naphthalene: Refined £32 10s. to £35; salts 80s., bags included.

Toluol: Naked, London 2s. 4d.; North 2s. 3d.

Creosote: Nominal, London 4¼d.; North 3¾d.; heavy oil, 4¼d. per gallon in bulk.

Anthracene: "A" quality, 40-45%, 4½d. per unit; "B" quality, 1¾d. to 2¼d.

Cresylic Acid: 95%, 2s. 6d.; 97-99%, 2s. 6d. to 2s. 7d.; Glasgow 2s. 3d. *ex* works London and f.o.b. other ports.

Grease Oils 18° Tw. (naked) £6 per ton f.o.r. makers' works.

Sulphate of Ammonia.

The home demand for sulphate remains good, and the official view is that next year's requirements will be very heavy, with yet further restrictions on the export trade. Foreign inquiries are still in good number; but they are not allowed to be filled. Across the Atlantic, production has practically overtaken demand, and there will soon be an exportable balance. This will naturally militate against any foreign trade in sulphate that this country might be able to cater for from time to time. The third annual report of the Sulphate of Ammonia Association is now to hand; and manufacturers are disappointed that no reference is made therein to the low export values lately ruling. The report suggests that all export sales should be left in the hands of the Association when Government control is removed. But many manufacturers hold the view that, although conditions will be entirely altered when the Government removes the export restrictions, the past five months' working through the Association is not much recommendation. On the other hand, it is argued that future export values will be on a higher scale; and the Association's methods certainly make for simplicity and economy in handling large orders. With regard to the home trade, the report expresses regret that protests to the Government have not been more effective in improving the fixed prices for home agricultural consumption (which remain in force until May of next year). Statements are being prepared, however, to show that sulphate of ammonia makers are obtaining a far less good return at present prices than before the war, and, when prices come to be fixed again, every effort will be made to secure improvement. In this connection, it is argued that the farmer now has his Corn Production Act guaranteeing him certain fixed prices for cereals. One of the conditions prevailing at the time of passing the Act was the present fixed range of quotations for sulphate of ammonia; and, consequently, any attempt to raise sulphate prices will create considerable opposition from a quarter which the Government could not afford to ignore at the present time. The time for energetic protest was before the passing of the Act, as was pointed out at the time; and if such a statement, as is now proposed, had been put forward then, it would probably have achieved its purpose. Whether it will do so now is very doubtful, although something might be arranged on the lines of a subsidy to the trade supplying agricultural sulphate during the currency of the Corn Production Act.

Meter Inspector Charged with Theft.—At Dewsbury West Riding Police Court last week, Richard Crawshaw, a meter inspector in the employ of the Heckmondwike and Liversedge Gas Company, was fined 20s., with the alternative of a month's imprisonment, for stealing 18s. 6d., the property of the Company. He had examined the meter at a certain house in June; but in August it was found that, though the consumption of gas showed that the meter should contain £1 9s. 8d., there was only 11s. 2d. The second inspector was told by the occupier that the previous inspector had said he would give a receipt for the money next time. Defendant stated that he had intended putting the money back.

WAR ECONOMY.

MINIMISE WASTE by INCREASED CONTROL.

Pressure and Vacuum Recorders and Indicators.

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SIMMANCE'S DEAD BEAT PATENT.

Extensive choice of ranges to meet all requirements.

ALEXANDER WRIGHT & CO., LTD., WESTMINSTER.

Compensation in a Gas Suffocation Case.

At the Colne County Court, last Tuesday, Ethel Ombler and others were the applicants, and Mr. W. E. Green Emmott, J.P., of Emmott Hall, the respondent, in an arbitration case under the Workmen's Compensation Act. Mr. Eastham, for the applicants, said the latter were the dependants of a man named Ombler, a coachman, who, while acting as caretaker at the respondent's residence, was found dead in bed. It appeared that the gas-main was obstructed; and the trouble was removed by men from the gas-works. In all probability when Ombler went to bed the gas was either on so slightly that it was blown out, or it went out when the full supply came through the main, thus causing him to be suffocated. Mr. Eastham added that Mr. Emmott had offered to pay £200 and costs; and he had accepted this offer. His Honour entered judgment for the amount stated.

Incandescent Gas-Mantle Works.—A Company with this title, whose works are at High Barnet, has been registered, with a capital of £6000, to acquire all rights and interests of Messrs. Lowen, Hartridge, & Co., Ltd., in a secret process for the manufacture of silk gas-mantles.

Effect of Increased Consumption at Walsall.—Reporting to the Walsall Corporation Gas Committee, the Engineer (Mr. B. W. Smith) said he particularly wished to call attention to the marked increase in the consumption of gas, and to the fact that there would be much difficulty in coping with this increase if bad weather was experienced. There were only two more beds of retorts to put on, equal to 200,000 c.ft. per day; and it must be with the aid of the carburetted water-gas plant continuously working with the oil in stock that they would hope to carry through this winter. Thus for any breakdown there was no margin of safety.

Increased Price at Lincoln.—Considerable opposition to a suggested increase in the price of gas of 3d. per 1000 c.ft. was forthcoming at a meeting of the Lincoln Corporation. The adoption of the recommendation of the Committee, bringing up the charge to 2s. 9d. per 1000 c.ft., was moved by Alderman T. Wallis (the Chairman), who explained that there had been an advance of 2s. 6d. in the price of coal since Sept. 17. The increased price of gas would not apply to prepayment customers, slot-meters being used principally by the poorer people; but he warned them that they must not expect a reduction when the price to other customers was lowered. Mr. A. Taylor, who opposed the increase, pointed out that during the years 1908-15 £35,000 had been taken from the profits in relief of rates. He was not convinced that any increase of the present rates was necessary to cover the cost of production. Upon a vote being taken, the Committee's recommendation was rejected by nine votes to eight. Further consideration of the proposal by the Council in committee was then decided upon; and it was agreed to increase the price 3d. as from the December quarter.

Doncaster Gas Charges.—From Dec. 1 the Doncaster Town Council have decided to increase the price of gas by 3d. per 1000 c.ft., making the charge now 3s. 3d.

Ireland's Highest Gas Price.—The New Ross Gas Company have raised the price of gas by 1s. 3d. per 1000 c.ft., bringing it to 7s. 11d.—the highest figure in any of the Irish towns.

Gas for Power at Oldbury.—The Oldbury District Council have decided to increase the price of gas for power purposes by 3d. per 1000 c.ft. This course has been adopted owing to the increase in the price of coal, oil, and other materials used at the gas-works, and also the increased cost of labour. Since the last increase in the price of power gas, coal has gone up 3s. 6d. per ton, and wages were over £2000 a year more. The increase of 3d. per 1000 c.ft. would just about cover the increased cost, and they would not be making gas at a loss for power purposes. The Council have decided to supply gas for motors.

Late Gas Manager at Strabane.—At a meeting of Strabane (co. Tyrone) Urban Council, Mr. John M'Dermott moved that a superannuation allowance be granted to the late Gas Manager (Mr. Thomas Reilly), and Mr. M. Bradley seconded the motion. The matter had been before the Council on the previous occasion, when, by a majority, an allowance was granted; but on an appeal to the Local Government Board the decision was overruled. Mr. James White, J.P., moved, and Mr. J. Toorish seconded, as an amendment, that the question be not further proceeded with in view of the Local Government Board's ruling; and this was ultimately agreed to by a majority of members.

Malvern and the Coal Transport Scheme.—The new coal transport reorganization scheme is not working as satisfactorily at Malvern as was expected. The Gas Engineer states that for the past month there was only about 500 tons of coal allotted to the gas undertaking, against the cancelled quantity of 635 tons. If this decrease continues, it will very seriously affect the stocks at the works. The increased cost of the coal was estimated at £600 on present deliveries for the financial year; and for this no provision was made in the estimates. The Gas Committee, who have considered the matter, have instructed the Engineer to communicate with the authorities. The Committee have increased the price of coke by 3s. 4d. per ton.

Newton-in-Makerfield and Maximum Price Revision.—Arising out of the increased price to be paid for coal, the Clerk at the last meeting of the Newton-in-Makerfield Urban District Council reported that, inasmuch as the maximum amount permitted to be charged for gas was now being charged (at, or below which profits could be taken in aid of the general improvement rate), it would be advisable, in case any increase should be necessary, for application to be made to the Local Government Board for a Provisional Order to amend the Newton-in-Makerfield Order of 1913. It was decided to make application to the Local Government Board for authority to increase the maximum price chargeable from 3s. to 4s. per 1000 c.ft. This maximum price only applies where the Council desire to utilize the profits arising from the gas undertaking.

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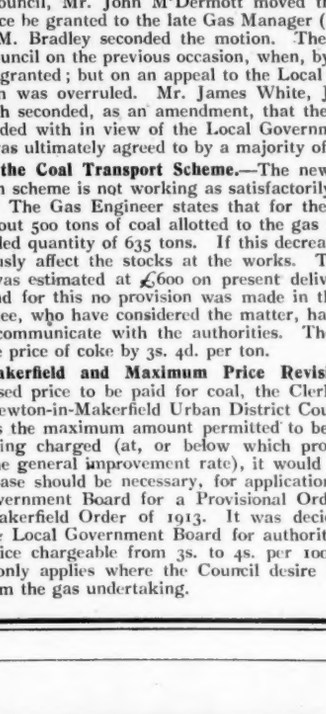

DOUBLE-COLUMN RADIATOR.

Dublin Gas Workers' Wages.—The Alliance and Dublin Consumers' Gas Company having replied to a demand by a number of their employees who are members of the Irish Transport Workers' Union for an all-round increase of 10s. a week in wages, that they were unable to make the concession, and suggesting that the matter should be referred to the Board of Trade for arbitration, a mass meeting of the men agreed to the suggestion, on condition that the arbitration should take place within the fortnight ending the 22nd inst. The Union are to be allowed to nominate certain of the arbitrators. The slot-meter collectors are asking £2 10s. per week, their present wages being 33s.

Limerick Gas Prices.—The Limerick Corporation are applying to the Irish Local Government Board to have the local Gas Act of 1878 amended, with a view to securing power to increase the price of gas 1s. per 1000 c.ft., making the price in the borough 6s. and that outside 7s.—the amendment to remain in force during the war period, and for two years thereafter. It is stated that the demands upon the Gas Committee are so heavy that the position of the improvement fund is precarious; and unless means are provided for increasing the 5s. rate, complete bankruptcy will result. In order to provide for the increased wages to their workers, the Committee have raised the price of coke to 53s. 4d., and that of breeze or small coke to 25s. per ton.

Wages Advance to Engineers.—An award has been issued by the Committee on Production, giving a further advance of wages to all grades of workmen employed by members of the Engineering Employers' Federation. The award is in pursuance of an agreement between the Federation and 48 trade unions connected with the engineering and foundry trades, under the terms of which the Committee on Production may be called upon at intervals of four months to consider whether an alteration in wages is warranted by abnormal conditions due to the war. Previous awards constituted an advance of 15s. weekly on pre-war rates; the present increase of 5s. bringing the total advance to 20s.

South Brisbane Gas Company.—There was reported at the 63rd half-yearly meeting of the Company an increase in sales for ordinary lighting of 3·68 p.ct., and for heating of 16·35 p.ct.; but the prepayment meter consumption showed a decrease of 3·06 p.ct. The vertical retort installation is giving much satisfaction; one of the features being a disappearance of naphthalene trouble, which was previously a serious difficulty with the Company. The total cost of manufacture for the half year was £16,246, and for the previous six months £13,167. The present Engineer of the Company is Mr. F. H. Wedd, who will be remembered by many of the younger members of the profession on this side.

STOCK MARKET REPORT.

THE general characteristics of things on the Stock Exchange last week showed little, if any, variation from the ruling features of the week before. Markets for the most part were quiet enough in all conscience, and the attractions of a highly popular and patriotic Lord Mayor's Show on Friday took a slice out of the time available for business. Taking departments all round, they could not exactly be pronounced weak; but there was a lack of animation about them which lulled them into torpor. Dulness prevailed most on the opening days, after which the tone took a favourable turn, under the inspiring leadership of Home Government issues, which, if time had permitted, might have developed materially.

The 5 p.ct. War Loan in mid-week had a smart rise, followed more moderately by Consols and other leading lines. Home Rails, too, were able to initiate on Wednesday a partial recovery, prompted by a more hopeful forecast of future eventualities. The American Market was a little better; but Argentines gave way—the position of affairs out there being uncertain and unpromising.

The Foreign Market held some good points. French made a recovery, and the old favourites, Chinese and Japanese, were still popular. Russian movements were not wholly bad, but Brazilians were weaker. Among the Miscellaneous group, Rubber fluctuated a good bit, closing dull, and Oils fell and rose again. Breweries also moved unevenly; but Shipping securities were in good demand.

Business in the Gas Market was of the quietest description, and the total number of bargains recorded made up only a poor aggregate. About three-fourths of these were confined to the large undertakings—Gas Light and Coke and Imperial Continental. A few other companies had one or two apiece; but by far the larger number of the concerns were quite neglected. The general tendency, however, offered no ground for complaint, showing, as it did, the same unruffled firmness which has characterized the market for some time recently. There were only two variations made in quotations, both in the upward direction—Newcastle advancing 3 points and South Metropolitan one. The Money Market was easy.

Bargains done for cash during the week were as follows: On Monday, European 10⅜, Gas Light ordinary 70⅛, 70¼, 70⅜, 71, ditto preference 71, 71½, Imperial Continental 89½, 90, South Metropolitan debenture 56¼, Petersfield 14s. 6d., 15s., ditto preference 32s. 6d., 35s. On Tuesday, European 11 1/16, Gas Light ordinary 71, ditto preference 71½, Imperial Continental 89½, 89⅝, 90, Primitiva 37s. 6d., ditto preference 57s. 6d., South Metropolitan debenture 56, Sevenoaks B £10 18s. On Wednesday, Brentford 77¼, Gas Light ordinary 70, 70¼, 70⅛, preference 71, ditto debenture 56, Imperial Continental 89, South Metropolitan debenture 56, 56⅛, Tottenham "A" 92½, 93. On Thursday, Commercial 4 p.ct. 71, European 10⅜, Gas Light ordinary 70⅛, 70⅜, 70⅝, ditto preference 71½, Imperial Continental 89, 89½, 90, Monte Video 7⅜. On Friday, Bombay 5 1/16, 5⅛, Brentford "A" 79½, ditto "B" 76¼, European 10 7/16, Gas Light ordinary 70, 71, ditto preference 71¼, 71½, Imperial Continental 89½, 89⅝, 90, South Metropolitan 74⅞, 75, 75¼, Kingston-on-Thames 74½, 75.

The Bank rate is 5 p.ct., as fixed on April 5.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue. £	Share.	When Div. Dividend.	Prev. Div. or Div. & Bonus. p.c.	Last Dividend.	NAME.	Closing Prices. July 30, 1914.	Present Prices.	Lowest and Highest Prices of Bargains.
175,472	Stk.	Mar. 10	4	4%	Aldershot 4 p.c. Pref.	..	57—62	..
1,551,868	,,	April 8	2½	4⅜%	Alliance & Dublin Ord.	59—64	52—57	..
374,000	,,	July 10	4	4%	Do. 4 p.c. Deb.	76—79	57—62	..
280,000	5	April 29	7½	3/6	Bombay, Ltd.	5⅞—6⅛	4 15/16—5⅛	5 1/16—5⅛
50,000	10	Feb. 26	16	14%	Bournemouth Gas and Water: 10 p.c.	29—30	23—25	..
383,110	10	,,	7	7%	Bournemouth Gas and Water: B 7 p.c.	15—15½	10½—11	..
115,000	10	,,	6	6/-	Bournemouth Gas and Water: Pref. 6 p.c.	13½—14	9—9½	..
159,740	—	—	—	4%	Bournemouth Gas and Water: 4 p.c. Deb.	..	69—71	..
992,045	Stk.	Feb. 26	14	5 5/7%	Brentford A Consolid.	261—266	79—82	79½
734,920	,,	,,	11	4⅞%	Do. B New	204—209	76—79	76½—77½
55,000	,,	,,	5	5%	Do. 5 p.c. Pref.	109—111	81—86	..
221,400	,,	June 11	4	4%	Do. 4 p.c. Deb.	91—93	65—67	..
217,380	,,	Feb. 26	11	10%	Brighton & Hove Orig.	208—213	145—150	..
244,200	,,	,,	8	7%	Do. A Ord. Stk.	154—159	98—103	..
530,000	20	Mar. 26	12½	22/6	British	44—45	32—33	..
120,000	Stk.	June 26	4	4%	Do. 4 p.c. Deb. Stk.	88—90	63—70	..
245,771	,,	,,	4	4%	Buenos Aires 4 p.c. Deb.	85—87	53—56	..
100,000	10	—	—	—	Cape Town & Dis., Ltd.	1½—2½	3—3½	..
100,000	10	—	—	4½%	Do. 4½ p.c. Pref.	4—6	6½—7½	..
100,000	Stk.	June 26	4½	4½%	Do. 4½ p.c. Deb. Stk.	70—75	60—65	..
157,150	,,	Feb. 26	5	5%	Chester 5 p.c. Ord.	108—110	79—81	..
1,513,280	,,	Feb. 12	5/9/4	44/-	Commercial 4 p.c. Stk.	106—108	70—72	71
560 000	,,	,,	5½	40/-	Do. 3½ p.c. do.	103—105	64—66	..
475,000	,,	June 11	3	3%	Do. 3 p.c. Deb. Stk.	69½—71½	52—54	..
800,000	,,	,,	4	—	Continental Union Ltd.	76—79	39—41	..
200,000	,,	,,	7	—	Do. 7 p.c. Pref.	115—118	61—63	..
278,400	—	—	—	11½%	Croydon B and C 7 p.c.	..	165—175	..
—	—	—	—	10%	Do. E	..	..	..
492,270	Stk.	—	6	5⅛%	Derby Con. Stk.	123—125	95—100	..
55.000	,,	—	4	4%	Do. Deb. Stk.	102—104	80—83	..
1,002,180	10	July 29	10	5/0	European, Ltd.	17½—18	10½—11½	10⅝—11 1/16
16,313,430	Stk.	Feb. 10	4/17/4	37/4	Gas Light and Coke: 4 p.c. Ord.	98—102	69—71	70—71
2,600,000	,,	,,	3½	3⅛%	Gas Light and Coke: 3½ p.c. max.	76—79	56—58	..
4,062,235	,,	,,	4	4%	Gas Light and Coke: 4 p.c. Con. Pref.	96—99	70—72	71—71½
4,674,850	,,	June 11	3	3%	Gas Light and Coke: 3 p.c. Con. Deb.	72½—74½	55—57	56
130,000	,,	,,	10	10%	Gas Light and Coke: 10 p.c. Bonds	..	..	..
258,740	,,	Mar. 12	5	3⅛%	Hastings & St. L. 3½ p.c.	87—89	48—53	..
70,000	10	April 29	11	6%	Hongkong & China, Ltd.	16½—16½	7½—8½	..
96,600	—	—	—	9%	Hornsey 7 p.c.	..	115—125	..
181,000	Stk.	Mar. 12	7⅞	7%	Ilford A and C.	151—154	92—97	..
65,780	,,	,,	6⅜	5 5/7%	Do. B	115—118	72—77	..
65,500	,,	June 26	4	4%	Do. 4 p.c. Deb.	92—94	65—68	..
4,940,000	,,	May 14	9	4½%	Imperial Continental	150—160	89—92	89—90
1,235,000	,,	Feb. 12	3½	3⅛%	Do. 3½ p.c. Deb. Red.	84—86	55—57	..
235,242	,,	Mar. 12	6½	6½%	Lea Bridge Ord. 5 p.c.	119—121	82—87	..
2,498,905	,,	Feb. 26	10	5%	Liverpool 5 p.c. Ord. A	211—213	82½—83	..
					Liverpool 5 p.c. Ord. B	146—148		
306,088	,,	June 26	4	4%	Do. 4 p.c. Pr. Deb. Stk.	..	71—73	..
75,000	5	June 11	6	2/-	Malta & Mediterranean	4½—4¾	3¾—4	..
250,000	100	April 1	4½	4½%	Met. of Melbourne 4½ p.c. Deb.	99—101	88—98	..
541,920	20	May 28	4	6/-	Monte Video, Ltd.	11½—12	7⅞—8½	7⅞
1,875,892	Stk.	July 29	4½	4½%	Newcastle & Gatsh'd Con.	98½—99½	71½—75½	..
529,705	,,	June 26	3½	3½%	Do. 3½ p.c. Deb.	82—83	61—63	..
55,940	10	Feb. 26	7/14/0	7%	North Middlesex 7 p.c.	14—15	9½—10½	..
800,000	Stk.	May 14	8	8%	Oriental, Ltd.	117—122	104—106	..
60,000	5	Mar. 26	10	1/-	Ottoman, Ltd.	7½—7¾	2—3	..
60,000	50	Feb. 26	13	12%	Porisea, Island B	128—131	83—88	..
100,000	50	,,	12	11%	Do. C	118—121	73—78	..
52,000	50	,,	10	9%	Do. D	..	..	..
249,980	5	April 29	8	—	Primitiva Ord.	5½—6	1 7/16—2½	37/6
499,960	5	June 26	5	2/6	Do. 5 p.c. Pref.	4½—5	2 7/16—3½	57/6
521,600	100	June 2	4	4%	Do. 4 p.c. Deb.	91—93	78—80	..
—	—	—	—	4%	Do. ,, ,, 1911	..	..	..
346,198	Stk.	June 26	4	4%	River Plate 4 p.c. Deb.	85—87	59—64	..
150,000	10	May 14	6	6/-	San Paulo 6 p.c. Pref.	10½—11	7½—8	..
125,000	50	July 1	5	5%	San Paulo 5 p.c. Deb.	47—49	40—42	..
135,000	Stk.	Mar. 12	10	10%	Sheffield A	223—224		
209,984	,,	,,	10	10%	Sheffield B	222—224	180—184	..
523,500	,,	,,	10	10%	Sheffield C	220—222		
90,000	10	May 28	9	6/-	South African.	10½—11½	8½—9½	..
6,609,895	Stk.	Feb. 10	5/4/0	46/8	South Met. 4 p.c. Ord.	111—113	74—76	74½—75½
—	—	—	—	—	Do. Pref.	..	..	..
1,895,445	,,	July 10	3	3%	Do. 3 p.c. Deb.	72½—74½	55—57	56—56½
224,820	,,	Feb. 26	8½	7 5/7%	South Shields Con. Stk.	157—159	127—139	..
952,795	,,	,,	6	4⅜%	S'th Suburb'n Ord. 5 p.c.	114—116	75—77	..
60,000	,,	,,	5	5%	Do. 5 p.c. Pref.	110—112	75—77	..
135,000	—	—	—	4⅝%	Do. West Kent	..	..	..
187,558	Stk.	June 26	5	5%	Do. 5 p.c. Deb. Stk.	116—118	86—88	..
647,740	,,	May 14	5	5%	Southampton Ord.	99—102	76—78	..
120,000	,,	Feb. 12	7½	5 5/7%	Tottenham A 5 p.c.	135—138	92—97	92½—93
782,375	,,	,,	6	4⅜%	Tottenham District B 3½ p.c.	115—117	70—72	..
181,255	,,	June 26	4	4%	Tottenham District 4 p.c. Deb.	87—89	63—65	..
182,880	10	Dec. 30	5	—	Tuscan, Ltd.	5—6	1—2	..
149,900	10	July 1	5	5%	Do. 5 p.c. Deb. Red.	93—95	60—65	..
236,476	Stk.	Mar. 12	5	5%	Tynemouth 5 p.c. max.	108½—109½	89—91	..
					Wandsworth, Wimbledon, and Epsom—			..
30,000	,,	Feb. 26	8⅜	72/6	Wandsworth A 5 p.c.	151—156	112—117	..
255,636	,,	,,	6½	57/6	Do. B 3½ p.c.	129—134	97—99	..
108,075	,,	,,	5/17/3	50.9	Do. C 3½ p.c.	110—115	84—89	..
352,000	,,	,,	6½	51/3	Wimbledon 5 p.c.	117—122	85—90	..
98,000	,,	,,	6½	57/6	Epsom 5 p.c.	121—126	93—98	..
88,416	,,	June 26	3	3%	3 p.c. Deb. Stk.	66—69	50—53	..

Loss at Nelson.—There was a net loss of £1949 on the Nelson Corporation gas undertaking last year. For the previous year there was a net profit of £5309.

Electric Light Failure in London.—The failure of the electric light at about half-past five last Thursday afternoon, which is noted on another page in connection with the discussion on Mr. John West's paper, was not confined to the hall of the Royal Society of Arts. The West End was also affected; and in many cases business had to be suspended for some time. The current was restored at about seven o'clock.

Retford Gas-Works Accounts.—The accounts of the Retford Corporation gas undertaking state that the amount received from gas and stove rents for the past year showed a decrease of £1559; while residuals realized £135 less. The gross profits for the year were £1085. Supplies of coal have been secured by the Committee for another twelve months at the same prices as last year, subject to the Coal Controller's alterations.

Gas Prices in Scotland.—Owing to the increased cost of coal recently authorized by the Controller, the Corporation of Greenock have decided to increase the price of gas 5d. per 1000 c.ft. The Gas Committee of the Dumfries Town Council have added 4d. per 1000 c.ft. to the rate for gas, as follows: Ordinary consumers, 3s. 6d.; prepayment meters, 3s. 11d.; public lighting, 3s. 6d.; and gas-engines, 3s. 3d. The estimated consumption of gas between now and May next is 76,629,500 c.ft.

Leeds and the Price of Coal.—In submitting to the City Council a higher scale of charges for gas in Leeds, Alderman Penrose-Green (the Chairman of the Gas Committee) said the increase in the price of coal alone represented a cost of £120,000 a year to the department. The increase in wages represented £45,000 a year over what was paid two years ago. The new price, which comes into force next year, is 3s. 1d. per 1000 c.ft. where the consumption per quarter is under 500,000 c.ft.—an increase of 3½d.

Low Temperature Development Trust, Ltd.—This is the title of a Company registered with a capital of £15,000, in 14,950 ordinary shares of £1 each and 1000 founders shares of 1s. each. The numerous "objects" of the Company include, among other things, "to search for, get, win," &c., any minerals, including oil, salt, coal, cannel, iron, shale, &c.; also the purchase of patents, licences, &c., and the expenditure of money in experimenting, &c. The signatories to the Company are W. A. Bramsdon, A. E. Timbrell, and J. W. Shawyer. The registered offices are at 16, Regent Street, S.W.

Huddersfield Gas Undertaking.—The annual report of the municipal undertakings at Huddersfield shows that during the year ended March last, the income of the Gas Department was £143,920, and the expenditure £120,285 (which included allowances to men on military service £511), leaving a gross profit of £23,635. After deduction of £13,926 interest on loans, and £1717 for sinking fund, the surplus is £7991. It is reported that there was an increase in the use of gas for heating, cooking, and industrial purposes; but the total output had been 4·66 p.ct. less than in the previous year, due entirely to the operation of the Summer Time Act.

Lurgan Gas Undertaking.—At a meeting of the Lurgan Urban Council, the Gas-Works Committee recommended that Mr. Tallentire, the Manager, be granted a bonus of £25 to his salary of £300 a year. Mr. Ballentine, while not opposing the bonus, asked "where the gas-works were drifting to," and inquired whether the ratepayers were not to be considered. Last year the total profits on the works were £6; and this year they would have £100 extra, or more, to pay for coal. It was eventually agreed to refer the recommendation back for reconsideration. The question of applying for a Provisional Order to empower the Council to raise the price of gas—now 4s. 6d. per 1000 c.ft.—was sent to the Gas Committee. A similar proposal was rejected on a former occasion.

The Alleged Gas-Works Nuisance at York.—In a report regarding the alleged nuisance from the gas-works, the York City Council Inspector of Nuisances says that the Company's works at Foss Bank have been kept under observation; and he visited the premises on Aug. 29 and 30, and also on Oct. 3. On the first two occasions, he found the nuisance was very bad; and with the exception of the continuance of the work of reconstruction of the retorts, nothing further had been done to abate the nuisance. On Oct. 3, though he found smoke and dust were being emitted from the works, they were in less quantities than previously; and he was informed that a new sprayer had been recently fitted to the charging machine, and that some improvement had thereby been effected. With the exception of three beds of retorts which are in course of reconstruction, all the retorts have been reconstructed, with a view to a general improvement of the premises. He is still of opinion, however, that some mechanical means are required for dealing with the smoke and dust.

The Ilkeston Corporation have increased the price of gas from 3s. 6d. to 4s. 2d. per 1000 c.ft.

Mr. Joseph Taylor, of the firm of Joseph Taylor and Co., of Bolton, has been unanimously elected Vice-Chairman of the Bolton Corporation Gas Committee.

The electric light failed at Bettws-y-coed last week under unusual circumstances. The current is generated by means of water power derived from Elsie Lake, situated at a high altitude above the village. On Thursday evening the water supply suddenly ceased; and inspection revealed the presence of a huge eel in the connecting-pipe.

Mr. W. J. Hassam, moving the adoption of the Gas Committee's report at the meeting last week of the Wolstanton United Urban District Council, stated that the estimated expenditure was some £800 or £900 more than last year. As, however, the receipts were expected to increase correspondingly, it was recommended that the price of gas should not be increased. The report was approved.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for Nov. 7.]

Nos. 15,692—16,075.

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